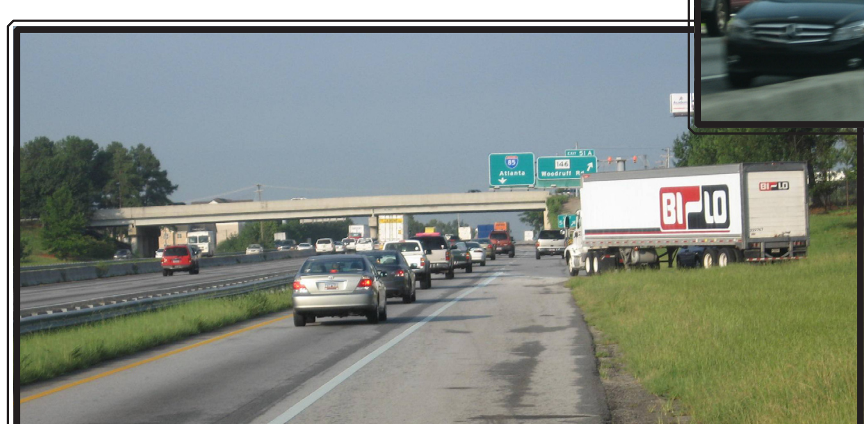
Chapter 1: Introduction



The study of the I-85 Corridor between the cities of Greenville and Spartanburg in South Carolina is intended to provide decision makers with a broad range of options for improvements along this 22-mile stretch of I-85. The strategies in this report are grouped into the categories of **travel demand management (TDM), modal, operational, and capacity**. The strategies include localized strategies as well as corridor-length improvements. The development and evaluation of these various strategies are described in this report. Strategies for both short-term and long-term implementation were evaluated and prioritized by potential benefits and cost of implementation. This corridor study provides a "cafeteria" list of improvements sorted by benefit, cost and ease of implementation. This study provides the needed support to state, regional, and local governments to make informed decisions regarding transportation along the I-85 corridor.

1.1 STUDY OVERSIGHT

The Planning and Environmental Office of the South Carolina Department of Transportation (SCDOT) provided management and oversight of the corridor study. A steering committee including transportation engineers and planners from SCDOT, FHWA, the Greenville-Pickens Area Transportation Study (GPATS), the Spartanburg Area Transportation Study (SPATS), The Appalachian Council of Governments (APCOG), GreenLink (transit), and the Greenville Spartanburg Airport (GSP) provided guidance for the study. A stakeholder group including representatives of four municipalities, county governments, chamber of commerce, airport, major industries, citizens, metropolitan planning organizations, council of governments, and SCDOT provided input as the study advanced.

1.2 BACKGROUND

The I-85 Corridor Analysis was initiated by SCDOT to identify ways to reduce congestion and improve traffic flow along the I-85 corridor between US 25 and SC 129. The study began in March 2010 and was completed in Spring 2012. The SCDOT initiated the study due to this 22-mile segment in Greenville and Spartanburg Counties being identified in SCDOT's Interstate Long-Range Plan as a priority capacity improvement need. The I-85 corridor experiences a high amount of volume, with the trucking industry comprising a large portion of this traffic. I-85 is a vital transportation link between Greenville and Spartanburg, locally and Charlotte to Atlanta regionally.

1.3 ECONOMIC VITALITY

Interstate 85 was the first of the interstate routes in South Carolina to be completed. I-85 was opened for its entire length across the state in 1964 at a total cost of $267 million. From the start, I-85 brought an economic boom to the areas of South Carolina through which it passed. An article in the *Columbia*

State and Record, December 8, 1963, pointed out that land values in Greenville County had doubled in 10 years, with most of the increase occurring along I-85. A Greenville Chamber of Commerce official said:

> *"We can't bring in an industrial client who is not impressed with what the Interstate has to offer . . . . Transportation really is our lifeblood."*

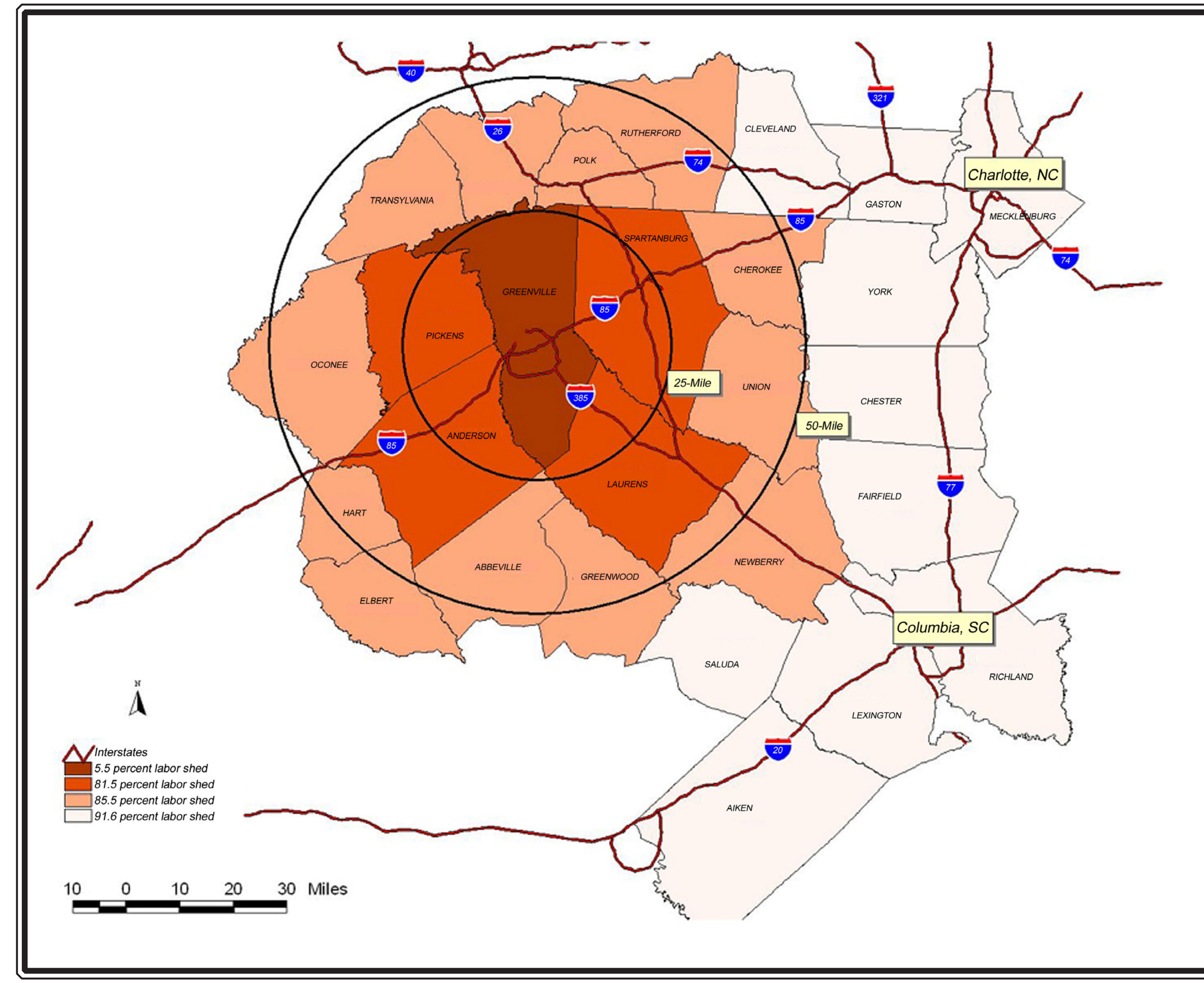
The economic impact of I-85 was highlighted in *Business Week* magazine on September 27, 1993. The cover headline read: "Drive Interstate 85 from Georgia to the Carolinas, and you'll travel through the heart of an economic success story."

The "Boom Belt" article in *Business Week* explained how Greer became the location of a BMW plant. The article noted "The only site that appealed to BMW executives was a 1000-acre tract off Interstate 85." While the corridor possessed many economic advantages to industry, Interstate 85, by providing the essential transportation ingredient, opened the door to opportunity.[1]

Interstate 85 is still very much the lifeblood of current industry and commerce along the study corridor. The economic vitality of existing industry and commerce depends to a large degree on the ability to move people, materials, and products in a very reliable and efficient manner. Many of the residents in the Greenville-Spartanburg area use I-85 to commute to places of employment, educational facilities, and heath care services. An efficient transportation system allows employees to arrive at their work place on a predictable schedule. An efficient transportation system also broadens the pool of available workers for existing and future industry and commerce. Interstate 85 runs through the heart of the Greenville County Labor Shed (See Exhibit 1), illustrating the importance of I-85 to present and future employers and employees in the Greenville-Spartanburg area.

Many industries along the I-85 corridor depend heavily on the ability to receive materials and transport products. I-85 links the Greenville-Spartanburg area to markets in Atlanta, Charlotte and beyond. Additionally, I-85 serves as link to the Charleston Port, approximately 200 miles away. The distance allows freight carriers to bring materials from the port and return with a load of finished products for export in the same day. Many industries along the I-85 corridor store very little material inventory on site, but rely on "just in time delivery" of materials for the manufacturing process. Efficient, reliable transportation is essential. The photographs in Exhibit 2 illustrate the freight movement along the corridor.

Exhibit 1: Labor Shed Map[2]



Today congestion is growing along this important transportation artery, threatening to slow the flow of the lifeblood of economic vitality, transportation. In order to maintain the current economic growth and assure future economic vitality, concurrent and future congestion must be controlled and reduced.

[1] U.S. Department of Transportation, Federal Highway Administration, Highway History, www.fhwa.dot.gov/infrastucture/boombelt

[2] Greenville Area Development Corporation (www.greenvilleeconomicdevelopment.com), April 18, 2012

Exhibit 2: Freight as Part of Corridor Traffic

1.4 PURPOSE OF THE STUDY

The corridor analysis study was intended to identify measures that will relieve congestion and improve safety along the 22-mile segment of I-85, both for present traffic conditions as well as forecasted future traffic.

Various evaluation techniques were used in this study including traffic analysis, travel demand modeling, corridor geometric evaluations, and identification of different strategies to be implemented. Current and projected levels of congestion were measured, travel patterns were identified, and potential impacts/benefits were studied during the analysis phase in order to identify a series of potential projects to improve the corridor.

This report documents the study completed in 2012 and provides a list of improvements sorted by benefit, cost and ease of implementation in order to provide the needed support for SCDOT and other agencies responsible for transportation to make informed decisions. Many of the improvements are relatively low cost and can reduce congestion and thus forestall the need and expense of constructing additional travel lanes.

1.5 STUDY CORRIDOR DESCRIPTION

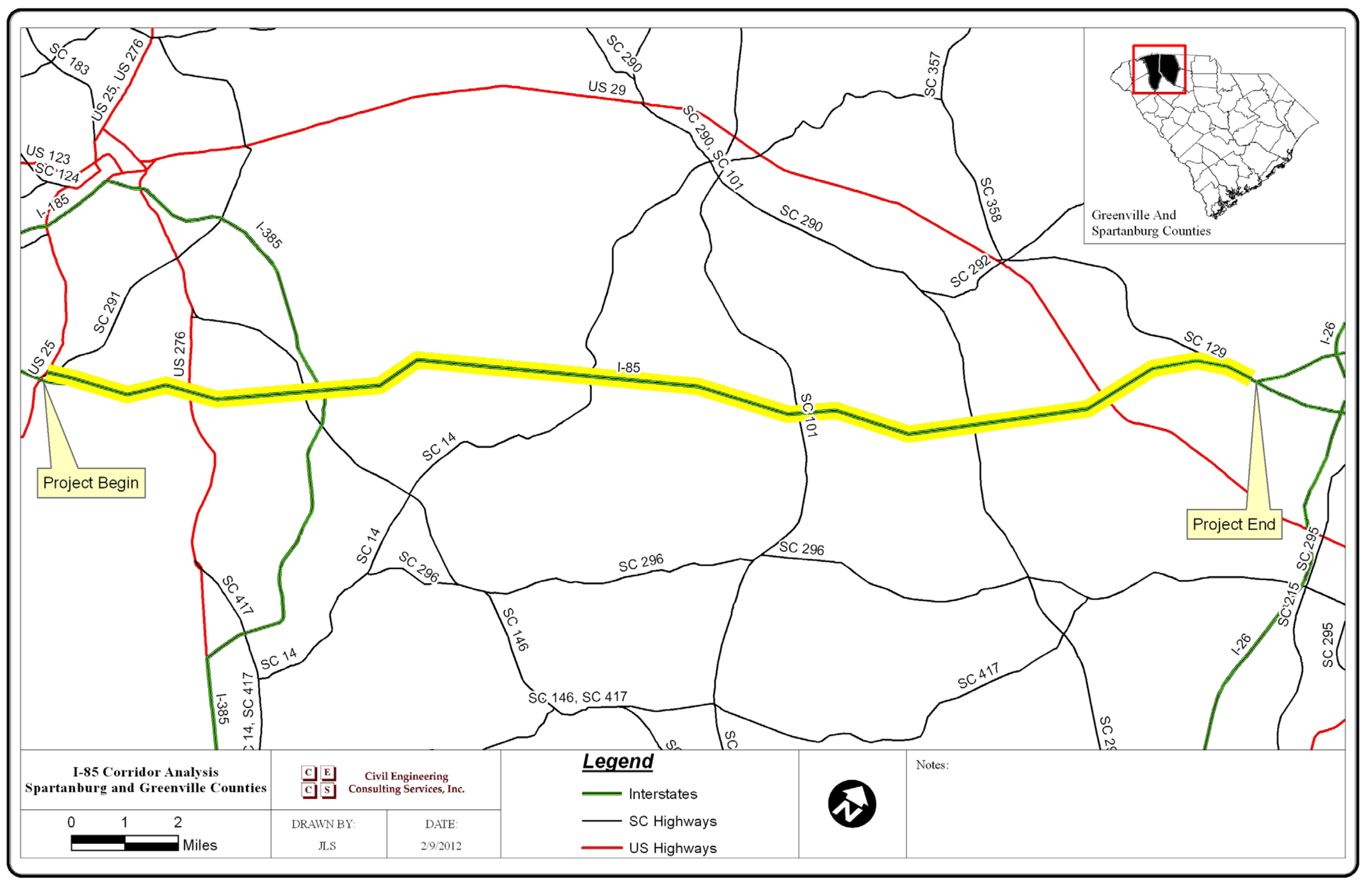
As shown in Exhibit 3, the 22-mile segment of I-85 under study in this corridor analysis begins at the intersection of I-85 and US 25 (White House Road) in Greenville County and terminates at the junction of I-85 and SC 129 (Fort Prince Boulevard) in Spartanburg County.

Along the corridor, the lane widths vary from six lanes to eight lanes with variable median widths throughout. In some places, the roadway has been set up to accommodate eight lanes even though it is currently six lanes. Parts of the roadway system have not been upgraded since their design in the mid-1950s, while other sections have been modified in the 1980s, 1990s, and most recently 2000-2005. Any redesign will have to take into consideration the most recent SCDOT and AASHTO design criteria and, where feasible, design exceptions previously implemented.

There are 15 interchanges on this 22-mile section of I-85; these interchanges consist of nine partial-cloverleaf designs, one full cloverleaf interchange, one diamond interchange, one directional interchange, one single point urban interchange (SPUI), one trumpet interchange, and one three-leg directional interchange. The directional interchange at I-85 / I-385 is the only interstate to interstate interchange on the corridor. Three of these interchanges (US 276, I-385 including Woodruff Road, and US 29) would require modification due to the 8-lane widening of I-85. Others may be evaluated for redesign based on improved traffic flow or capacity.

There are 11 mainline I-85 overpass bridge locations as well as 24 underpass bridge locations. The overpass bridges are typically dual structures – northbound and southbound – and may include auxiliary lanes associated with interchanges. Some of these overpass bridges were built in the 1990s and substructure was built to allow for top-down construction of a fourth lane in each direction in the future. Of the 11 existing overpass bridge locations, three would be replaced in the event of an 8-lane widening and designed using current SCDOT and AASHTO criteria. These are the southbound bridge over the Reedy River, the dual bridges over US 276, and the dual bridges over CSX railroad. Some of the underpass bridges were also built in the mid-1990s and accommodate eight through lanes. Of the existing 24 underpass bridges, 11 should be replaced and designed to current standards. The remaining 21 bridge structures (overpasses and underpasses) should not be replaced until warranted by functionality or structural deficiency.

Exhibit 3: Map of Study Area



1.6 FUNDING

Traditionally, the solution to congestion and heavy traffic volumes has been to construct additional lanes to meet the increased travel demand. Constructing one additional lane in each direction along the 22-mile length of the corridor may cost more than $500 million which is more than the total federal interstate funds received by SCDOT in a three-year period. For this reason, SCDOT has identified the improvement of the I-85 corridor as a "Mega" project.

Due to the high cost of traditional widening and the limited current and future funds for construction on interstate highways in South Carolina, SCDOT has embarked on a different approach to managing congestion on I-85. Ten million dollars was identified by SCDOT in fiscal year 2009 for the study and improvement of I-85 between Greenville and Spartanburg. The study is a comprehensive approach to managing congestion.

This study identifies many strategies for relieving congestion in both the near-term and twenty years into the future. A number of these strategies involve reducing travel demand, increasing the use of modes of travel other than private automobiles, and smaller highway improvements to improve traffic operations. Many of these strategies are low cost and could be implemented quickly to improve traffic flow on I-85. Additionally, local governments and transportation planning agencies in partnership with SCDOT could implement many of these strategies; thus bringing supplemental funding from non-traditional sources to achieve the goal of managing congestion on I-85.

1.7 CONGESTION MANAGEMENT PROCESS (CMP)

Much like people, each interstate highway has its own "personality" which is rooted in the surrounding communities and businesses, the travel patterns of the area, alternate transportation options, the terrain, age of the facility, location within the regional interstate system, and a number of other factors. Reducing congestion on any large urban freeway, like the I-85 corridor, requires a systematic approach. A systematic approach must include an analysis of the existing highway based on historic and measured data. The approach must look at a wide spectrum of strategies that may affect travel demand, transportation opportunities, and highway operations.

The Congestion Management Process (CMP), as shown in Exhibit 4, is a continuing process being used to improve traffic flow and reduce congestion on I-85. This study accomplishes the steps identified as "Data Collection & Analysis" and "Strategy Evaluation". The results of this study are a number of recommendations for managing congestion on I-85 that are sorted by benefit, cost, and implementation schedule. These recommendations are included in Chapter 11 of this study and provide for the next step in the process "Strategy Implementation & Project Programming."

Exhibit 4: Congestion Management Process

Chapter 2: Existing Conditions

2.1 LOCATION

Greenville and Spartanburg Counties are located in the northwest region of South Carolina. According to the US Census Bureau, Greenville County had an estimated population of 451,428 in the year 2010, making it the most populous county in the state of South Carolina. Spartanburg County had an estimated 2010 population of 284,307.

2.2 FACILITIES

Interchanges

The 15 interchanges in this corridor are of various age and configuration. The four interchanges west of the Reedy River are partial cloverleaf designs that were rebuilt in the mid-1990s and incorporate a collector-distributor (CD) system in both the northbound and southbound directions of I-85. The US 276 Interchange is a full cloverleaf with no CD roads. This section of I-85 was widened to six lanes in the mid-1980s. Woodruff Road is a partial cloverleaf with one loop and the I-85/385 Interchange is a partially directional interchange with loops. Pelham Road has a partial cloverleaf configuration. SC 14 is the only SPUI on this corridor. The Aviation Drive Interchange is a trumpet configuration with CD-road interconnectivity to SC 14. The I-85 access improvements interchange, just north of Brockman-McClimon Road, is a three leg directional design. SC 101 is a partial cloverleaf, SC 290 is a diamond, and US 29 as well as SC 129 are partial cloverleaf designs. The last interchange on the corridor is the I-85 Bypass/I-85 Business interchange which is a three leg directional configuration. Exhibit 6 notes the approximate date these interchanges were constructed/reconstructed and whether the redesign incorporated additional clearance to accommodate added capacity on I-85.

Bridges

The bridges in this corridor are a combination of underpass (bridge crossing over I-85) and overpass (I-85 over a cross road or water body) structures. Some of the underpass bridges were built in the mid-1990s and have sufficient horizontal clearances to accommodate future widening of I-85. Also, some of the overpass bridges were built in the mid-1990s and the substructure was built to allow for top-down construction of a fourth lane in each direction in the future.

The overpass bridges are typically dual structures – northbound and southbound – and may include auxiliary lanes associated with interchanges. Exhibit 5 includes approximate dates of construction as well as other information about the bridges. Underpass bridges in interchanges are identified by the interchange.

Exhibit 5: Existing Bridges

No.	Location	Type	Notes	Seismic Design F	Seismic Design D	Approx. Year Built/ Widened
1	US 25 Bypass (White Horse Road)	Partial cloverleaf interchange	Set up for 8 through lanes	N	Y	1995
2	Brushy Creek	Overpass bridges	Substructure in place for future widening	N	Y	1997
3	US25 Business (Augusta Road)	Partial cloverleaf interchange	Set up for 8 through lanes	N	Y	1995
4	SC291 (Pleasantburg Drive)	Partial cloverleaf interchange	Set up for 8 through lanes	N	Y	1994
5	Mauldin Road (S-107)	Partial cloverleaf interchange	Set up for 8 through lanes	N	Y	1994
6	Reedy River	Overpass bridges	Date of SB bridge unknown	N	Y	1994 (NB)
7	Ridge Road (S-435)	Underpass bridge	2-lane roadway, replace		N	1959
8	US276	Full cloverleaf interchange	6-lane interchange with weaving, replace	N	N	1985 (widened)
9	CSX Railroad	Overpass bridges	6-lane, replace	N	N	1985 (widened)
10	Salters Road (S-326)	Underpass bridge	2-lane roadway, replacement planned	N	N	1959
11	Woodruff Road (SC146)	Partial cloverleaf interchange	Replace as part of the I-85/385 interchange	N	N	1985
12	I-385	Directional interchange	To be modified	N	N	2012 (proposed)
13	Roper Mountain Road (S-183)	Underpass bridge	Replace as part of the I-85/385 interchange	N	N	1982
14	Pelham Road (S-492)	Partial cloverleaf interchange	Will accommodate 8 through lanes	N	N	1990
15	Batesville Road (S-164)	Underpass bridge	2-lane roadway, replace	N	N	1958
16	Enoree River	Overpass bridges	Substructure in place for 8 lanes	N	Y	1999
17	SC14	SPUI interchange	Set up for 8 through lanes	N	Y	2000
18	Jetport	Trumpet interchange	Set up for 8 through lanes	Y	Y	2005
19	Brockman-McClimon Road (S-12)	Underpass bridge	Set up for 8 through lanes	Y	Y	2005
20	I-85 Access Improvements	Three leg directional interchange	Set up for 8 through lanes	Y	Y	2005
21	SC101	Partial cloverleaf interchange	Will accommodate 8 through lanes	N	Y	1994
22	Duncan-Reidville Road (S-62)	Underpass bridge	2-lane roadway, replace	N	Y	1958
23	Danzler Road (S-242)	Underpass bridge	2-lane roadway, replace	N	Y	1958
24	South Tyger River	Overpass bridges	Substructure in place for 8 lanes	N	Y	1999
25	SC290	Diamond interchange	Will accommodate 8 through lanes	N	Y	1992
26	Middle Tyger River	Overpass bridges	Substructure in place for 8 lanes	N	Y	1999
27	Nazareth Road (S-1036)	Underpass bridge	2-lane roadway, replace	N	N	1958
28	US29	Partial cloverleaf interchange	Some I-85 bridge modified done in 1999. Modify ramps and ramp bridges	N	Y	1999
29	Southern Railroad	Overpass bridges	Widen for 8 lanes	N	Y	1999
30	North Tyger River	Overpass bridges	Substructure in place for 8 lanes	N	Y	1999
31	SC 129	Partial cloverleaf interchange	Set up for 8 through lanes	N	N	1992
32	I-85 Bypass/ I-85 Business	Three leg directional interchange	Corridor ends prior to this interchange	N	N	1988

Seismic Design: F= Full Design D= Details only *I-85 Corridor Summary Report*, Florence & Hutcheson, August 2010

ROADWAY

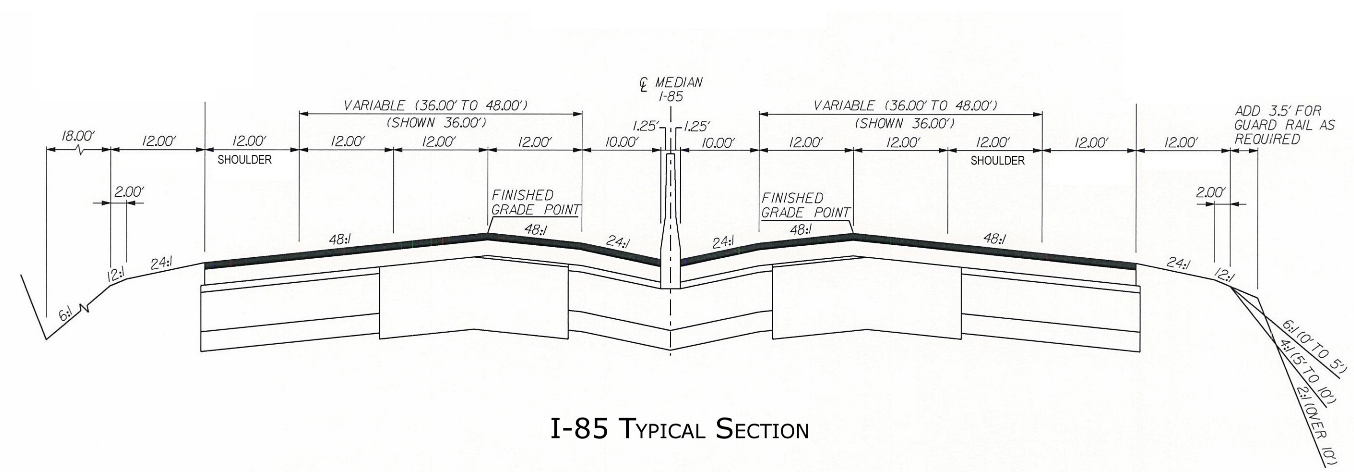
Interstate 85

I-85 is a major north-south connector extending approximately 326 miles from Montgomery, Alabama north to Petersburg, Virginia. Locally, it connects the cities of Greenville and Spartanburg, while regionally, it is a major route between Atlanta and Charlotte. In addition to the passenger car traffic, there are a large number of trucks that utilize this section of roadway. Roadways included in the study area are further described below. Average Annual Daily Traffic (AADT) for each of the roadways was obtained from SCDOT.

I-85 is a six-lane median-divided freeway providing three travel lanes in each direction as shown in Exhibit 6. I-85 serves as a primary north-south route for both long-distance and local drivers. It provides access regionally to both Charlotte and Atlanta, which are both trucking hubs for the southeastern United States. This roadway is currently a main north-south trucking route. The daily percentage of trucks on I-85 was provided by SCDOT and was estimated to be 28%. However, since this study was designed to analyze only the AM and PM peak travel periods, an alternate percentage was determined based on peak hour traffic counts, which were broken down by vehicle classification. The peak hour truck percentage used for the purposes of this study was determined to be 12%.

There are two, two-lane collector-distributor (CD) routes in the study area. The first is located on the southern end of the study area and provides access to Augusta Road, SC 291 (S. Pleasantburg Drive), and Mauldin Road The second provides access to SC 146 (Woodruff Road) and I-385. The speed limit throughout the study area is 60 miles per hour (mph). Year 2010 AADT data for I-85 is shown in Exhibit 7.

Exhibit 6: Typical Six-Lane Road Section



I-85 Typical Section

Exhibit 7: I-85 Average Annual Daily Traffic (AADT)

Segment	AADT – 2010 (Vehicles per day)
US 25 (White Horse Road) to Augusta Road	89,800
Augusta Road to Mauldin Road	95,400
Mauldin Road to US 276 (Laurens Road)	97,700
US 276 (Laurens Road) to SC 146 (Woodruff Road)	92,700
SC 146 (Woodruff Road) to I-385	91,000
I-385 to Pelham Road	111,600
Pelham Road to SC 14	93,000
SC 14 to Brockman-McClimon Road	82,300
Brockman-McClimon Road to SC 101	82,100
SC 101 to SC 290 (E. Main St.)	80,600
SC 290 (E. Main St.) to US 29	81,300
US 29 to SC 129 (Fort Prince Boulevard)	80,000
SC 129 (Fort Prince Boulevard) to I-85 Business	83,400

Crossing Routes

Augusta Road is a five-lane undivided highway with a center turn lane. It serves local drivers as an access to SC 291 (S. Pleasantburg Road), which has limited access to and from I-85. Augusta Road leads north into residential areas and ultimately into downtown Greenville. It leads south into residential communities as well as the Donaldson Center Airport and surrounding industrial areas. The percentage of trucks on this roadway is approximately 7%. The posted speed limit on Augusta Road is 35 mph. This roadway had a 2010 AADT value of 31,400 vehicles per day (vpd) north of the I-85 interchange and 18,300 vpd south of the I-85 interchange.

SC 291 (S. Pleasantburg Drive) is a six-lane undivided roadway north of I-85 and a seven-lane undivided highway south of I-85 with a center turn lane. It serves as an access route to the north into downtown Greenville and to the south to US 25, which leads to primarily residential communities. The percentage of trucks on this roadway is approximately 3%. The posted speed limit on S. Pleasantburg Drive is 45 mph. This roadway had a 2010 AADT value of 24,000 vpd north of the I-85 interchange and 25,900 south of the I-85 interchange.

Mauldin Road is a five-lane undivided roadway with a center turn lane. It serves as an access route to the north to a mix of residential and commercial areas and ultimately to downtown Greenville. To the south, Mauldin Road serves as a route to industrial complexes primarily. The percentage of trucks on Mauldin Road is approximately 4%. The speed limit on this roadway is 35 mph. Mauldin Road had a 2010 AADT value of 24,200 vpd north of the I-85 interchange and 25,400 vpd south of the I-85 interchange.

US 276 (Laurens Road) is a five-lane undivided roadway with a center turn lane west of I-85 and is a four-lane divided roadway east of I-85. It serves as an access route to the north to a mix of commercial and residential areas, and ultimately goes through downtown Greenville. To the south, US 276 leads to several industrial complexes as well as a school and multiple facilities for Clemson University's International Center for Automotive Research. It also leads into the downtown area of Mauldin, located south of the I-85 interchange. The percentage of trucks on this roadway is approximately 15%. The speed limit on US 276 is 40 mph. US 276 had a 2010 AADT value of 35,400 vpd north of the I-85 interchange and 27,600 vpd south of the I-85 interchange.

SC 146 (Woodruff Road) is a five-lane undivided roadway with a center turn lane west of I-85 and is a four-lane undivided roadway east of I-85. It serves as an access to primarily commercial developments both north and south of the I-85 interchange. It has access to I-385 to the east of the I-85 interchange. The percentage of trucks on this roadway is approximately 14%. Woodruff Road has a speed limit of 35 mph. The 2010 AADT on this roadway was 12,100 vpd north of the I-85 interchange and 32,200 vpd south of the I-85 interchange.

I-385 is a four-lane, median-divided freeway south of the I-85 interchange and an eight-lane median-divided freeway north of the I-85 interchange to Roper Mountain Road The roadway serves as a bypass around downtown Greenville and provides access to multiple commercial, industrial, and residential areas surrounding the city. The percentage of trucks on this roadway is approximately 16%. The speed limit on I-385 through the study area is 55 mph. The 2010 AADT on I-385 was 87,000 vpd north of the I-85 interchange and 92,000 vpd south of the I-85 interchange.

Pelham Road is a five-lane undivided roadway with a center turn lane. It provides access to both commercial and residential land uses to the west and commercial and industrial areas to the east. The percentage of trucks on this roadway is approximately 13%. Pelham Road has a speed limit of 40 mph through the study area. The roadway had a 2010 AADT of 18,400 vpd north of the I-85 interchange and 19,900 vpd south of the I-85 interchange.

SC 14 is a seven-lane undivided roadway with a center turn lane north of I-85 and a five-lane undivided highway with a center turn lane south of I-85. It provides access to primarily industrial and commercial areas on both the north and south sides of I-85. The percentage of trucks on this roadway is approximately 2%. The speed limit on SC 14 is 45 mph. The 2010 AADT on SC 14 was 15,600 vpd north of the I-85 interchange and 10,600 vpd south of the I-85 interchange.

Aviation Drive is a four-lane median-divided facility providing access to GSP. The percentage of trucks on this roadway is approximately 6%. The posted speed limit on Aviation Drive is 45 mph. The 2010 AADT for this roadway was 3,800 vpd.

Brockman-McClimon Road is a four-lane, median-divided facility providing access to rural areas of the town of Greer, SC. The road terminates at SC 101, to the north of I-85. The percentage of trucks on this roadway is approximately 6%. The posted speed limit on Brockman-McClimon Road is 45 mph. The 2010 AADT for this roadway was 1,950 vpd.

SC 101 is a five-lane undivided roadway with a center turn lane. It serves as a major access route to the BMW Manufacturing Plant, located just north of the I-85 interchange. The roadway also provides access to industrial facilities to the south of I-85. The percentage of trucks on SC 101 is approximately 11%. The posted speed limit on this roadway is 55 mph. The 2010 AADT on SC 101 was 15,800 vpd north of the I-85 interchange and 13,000 vpd south of the I-85 interchange.

SC 290 (E. Main St.) is a seven-lane undivided roadway with a center turn lane. It serves as an access route to commercial and industrial land uses south of the I-85 interchange and commercial and residential areas on the north side of the I-85 interchange. The percentage of trucks on SC 290 is approximately 11%. The posted speed limit on this roadway is 35 mph. The 2010 AADT on SC 290 was 14,900 vpd north of the I-85 interchange and 9,400 vpd south of the I-85 interchange.

US 29 (Spartanburg Highway) is a four-lane median-divided roadway that provides access to industrial and residential areas of the town of Lyman on both the east and west sides of the I-85 interchange. The town of Lyman is located west of I-85 on US 29. The percentage of trucks on US 29 is approximately 6%. The posted speed limit on this roadway is 45 mph. The 2010 AADT on US 29 was 13,400 vpd north of the I-85 interchange and 35,600 vpd south of the I-85 interchange.

SC 129 (Fort Prince Boulevard) is a two-lane undivided roadway providing access to residential areas on the north side of I-85 and to a large industrial plant on the south side of I-85. The percentage of trucks on SC 129 is approximately 5%. The posted speed limit on this roadway is 50 mph. The 2008 AADT on SC 129 was 7,500 vpd north of I-85.

I-85 Business is a four-lane median-divided freeway providing access to urban areas of Spartanburg. The posted speed limit on this roadway is 55 mph. The 2010 AADT on I-85 Business was 20,700 vpd.

2.3 EXISTING NEPA DOCUMENTS AND DESIGN CRITERIA

This section includes a review of existing NEPA documents, existing plans, and design standards.

NEPA Documents

The last major NEPA document prepared for the I-85 corridor is the Environmental Assessment (EA) developed for the proposed 8-lane widening of the 14.6-mile section of I-85 from Road S-492 (Pelham Road) northerly to SC 129 (Fort Prince Boulevard). The document was approved by the SCDOT and the FHWA in March 1998 and a FONSI was signed in June 1998.

Based on a review of this document and coordination with FHWA, it is recommended that a new NEPA document be completed for any proposed I-85 improvements. This recommendation is based on the following:

- Age of the original EA (1998) - 14 years old as of this report
- Widening to the outside which would require realignment/relocation of existing frontage roads, based on current criteria, necessitating additional rights-of-way
- Potential increase in damages/relocations due to new criteria
- Additional noise impacts
- Air quality issues due to potential changes in attainment/non-attainment designations by EPA
- Multiple smaller improvements, such as interchange ramp extensions, may require less complex, individual environmental documents

Design Criteria

Vertical Curves

The main roadway item of note that has changed from the 1990 version of the AASHTO A Policy on Geometric Design of Highways and Streets (commonly called the "green book") as compared to the 2001 version currently used by the SCDOT is criteria for sag and crest vertical curves.

To update vertical curvature to current standards, there are three options to consider:

1. Reduce posted speeds to accommodate current design requirements
2. Reconstruct substandard sag vertical curves to current design criteria
3. Use design exceptions on all I-85 substandard vertical curves

Different design speeds were assumed for the design of different sections of the I-85 corridor. The section of I-85 from White Horse Road to the Reedy River was designed using 60 mph. From the Reedy River through the end of the corridor, the design speed was 70 mph. During the previous reconstruction of I-85, design speeds ranging from 53 to 70 mph were retained for the section of I-85 from Roper Mountain Road to SC 129. The posted speed limit on this corridor is 60 mph from White Horse Road to SC 129 which increases to 70 mph north of the I-85 Bypass/I-85 Business interchange.

New criteria for sag vertical curves indicates that the design speeds would decrease based on existing geometry. Improvement of sags to current criteria would require a decrease in approach grades or an increase in length of vertical curve. This may be economically feasible for some sags that are adjacent to frontage roads that can be used for traffic staging. The most cost-effective solution would be to issue design exceptions for most vertical curves and evaluate the economy of reconstructing sags in those areas where the SCDOT and/or the FHWA deem necessary.

Ramps

Other criteria that have changed are for entrance and exit ramp styles – i.e. parallel ramps are now preferred over tapered ramps. As the Department has done for interchanges throughout the state, modifications to ramps can be accomplished as needed for safety and ease of traffic movement. SCDOT design preferences have evolved since some areas of I-85 were designed in the mid-1950s. For example, the I-85 weaving condition at the US 276 interchange should be evaluated for elimination. Due to changes in design criteria, the existing roadway plans for widening I-85 north from Pelham Road are obsolete and unusable.

Bridges

Beginning at the southern end of this corridor, all bridges from White Horse Road to north of the Reedy River were designed in the mid-1990s when the SCDOT had no policy on the seismic design of bridges. In place at that time were criteria for seismic "detailing" that were applicable to foundations, columns, and beam seats. The SB I-85 bridge over the Reedy River was built well prior to the early 1990s and did not undergo seismic retrofitting during the construction of I-85 Improvements in this area. Seismic retrofitting costs are variable and dependent on the structure configuration. It is recommended that these bridges not be replaced until it is warranted by functionality or structural deficiency. See Exhibit 3 for more information on bridges.

Chapter 10: Capacity Improvements

Improvements in capacity are generally accomplished by adding lanes to the highway. In this study, strategies for improving capacity include adding lanes to the mainline of I-85, reconstruction or reconfiguring interchanges, and the addition of lanes to a few selected ramps. Interchange reconstructing and selected ramp improvements are included in this chapter as capacity improvements due to the larger scale nature or expense of the proposed improvement. Additionally, the benefits of travel demand management and modal strategies in delaying or eliminating the need for additional highway lanes is evaluated.

10.1 WIDENING

As described previously in this report, traffic on I-85 is anticipated to continue to grow in volume based on historic trends. Adding more lanes to increase highway capacity could accommodate this projected increase in traffic. The addition of one base lane in each direction would provide four lanes in both the northbound and southbound direction and increase the base lanes on I-85 to a total of eight lanes. This concept is illustrated in Exhibit 79. To evaluate the effectiveness of this strategy, this widening was modeled in VISSIM for the year 2035 and called the 2035 4-Lane Build model. The model included four lanes in each direction from just north of White Horse Road to near the I-85 Business interchange. Improvements to the interchanges at Laurens Road, I-385, and SC 290 were included in the model along with the ramp improvements previously described in Chapter 9.

Travel demand management (TDM) and modal strategies were not included in the 2035 4-Lane Build model in order to develop a baseline for the effects of adding lanes. As identified in Chapter 7 of this report, the implementation of TDM and modal strategies has the potential to reduce the growth in volume of traffic using I-85 in future years. The benefits of TDM and modal strategies in delaying and/or eliminating the need for additional traffic lanes will be evaluated in this chapter.

The evaluation of the widening to a total of eight lanes shows adding lanes is beneficial to traffic flow when compared to making only the operational improvements in 2035. These benefits include reduced congestion, improved LOS and decreased travel times. The results of modeling the widened interstate corridor also revealed the need for an additional lane between some interchanges to provide LOS D. The additional lanes would be auxiliary lanes and begin at the entrance ramp for one interchange and end at the exit ramp for the next interchange. These lanes between interchanges that connect ramps would be designated as "EXIT ONLY" lanes and not be continuous throughout the corridor. The locations of these auxiliary lanes are given below:

- SB from entrance ramp just north of S. Pleasantburg Drive to White Horse Road (C24)
- NB & SB between north of Mauldin Road to Laurens Road ramps (C25, C26)

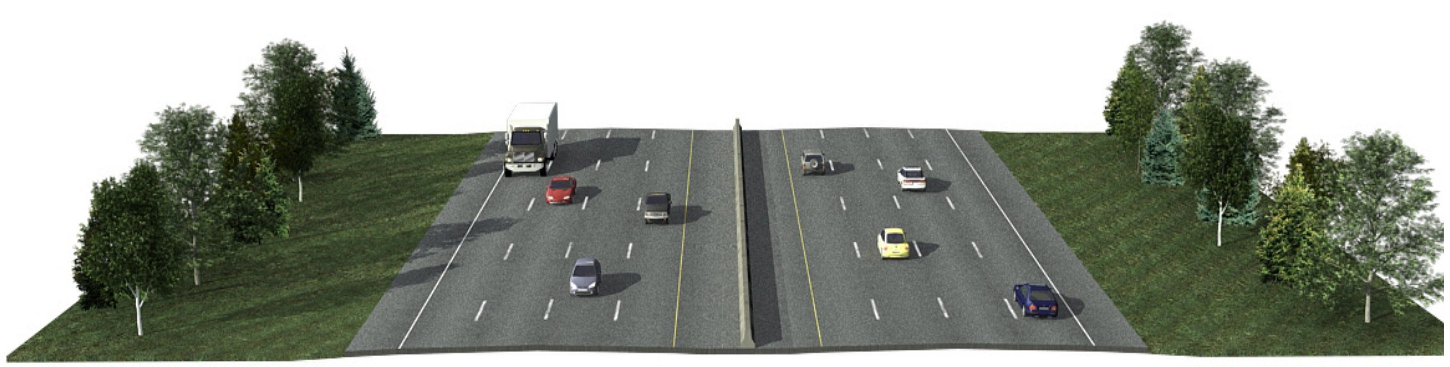
- SB between Laurens Road exit ramp and Woodruff Road entrance ramp (C27)
- NB & SB between I-385 ramps and SC 14 ramps (C28, C29)
- NB between SC 101 entrance ramp and SC 290 exit ramp (C30)
- NB between SC 129 entrance ramp and I-85 Business exit ramp (C22)
- NB between I-85 Business and I-26 exit ramp (C23)

A schematic of the eight-lane widened freeway is included in the Appendix A. The schematic is based on the results of the widening model (2035 4-Lane Build), which also includes ramp improvements, interchange improvements, and auxiliary lanes. The widening model and the schematic do not include the benefits of implementing TDM and modal strategies.

Fifth-Lane Additions (C22, C24 - C30)

In 2030, a fifth lane may be needed southbound between the SC 14 entrance ramp and the I-385/ Woodruff Road exit and northbound between I-385 entrance ramp and SC 14 exit ramp (C24). The bridge on Pelham Road over I-85 provides sufficient horizontal distance under the bridge to accommodate four lanes and the loop ramp from Pelham Road. Placement of the fifth lanes will require replacement of the Pelham Road bridge and the cost is included as part of strategies C28 and C29. The need for the fifth lane can be avoided or delayed beyond 2035 with the successful implementation of a number of the TDM and modal strategies. However, should the need for the fifth lane be realized in the future and the Pelham Road bridge needs to be replaced, it is recommended that more efficient interchange configurations be considered.

Exhibit 79: Typical Eight-Lane Roadway Section



Segment Widening

As traffic volumes grow from the actual 2010 counts to the 2035 projections, various segments along the corridor will need additional lanes sooner than others. In order to determine the sequence in which additional lanes may be needed, the projected traffic was broken into five-year increments. The HCM Basic Freeway Equation was used to evaluate the widening needs along the corridor based on the five-year incremental traffic projections. A segment was determined to need widening when LOS F was reached. Exhibit 80 shows the need for additional lanes in five-year increments without traffic reductions from the implementation of TDM or modal strategies under the heading "Without TDM and Modal Strategies". The needed lanes are shown for both northbound and southbound lanes.

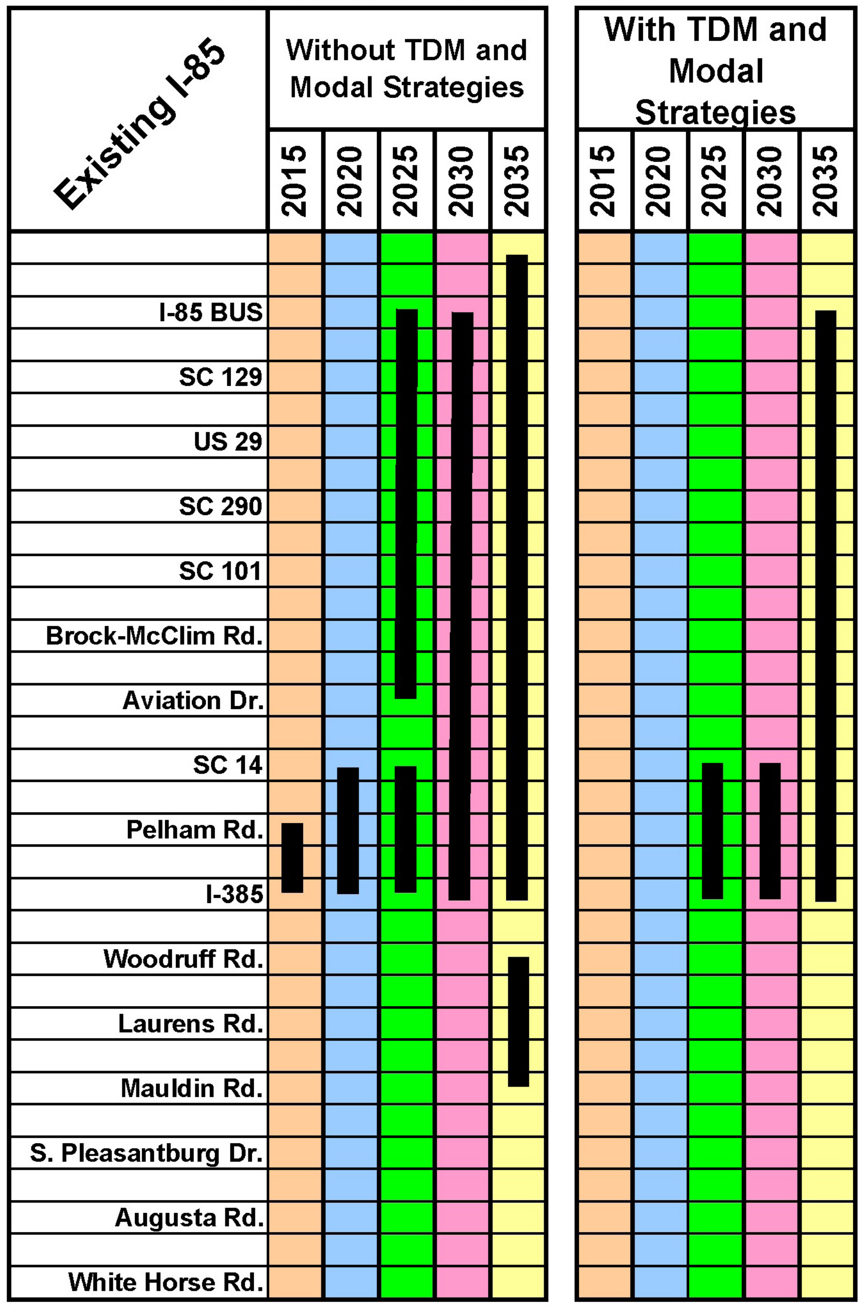
Consideration of TDM and Modal Strategies

Timely implementation of TDM and modal strategies will delay, or for some segments eliminate, the need to provide additional lanes prior to the 2035 study year. In order to determine a realistic projection of widening needs considering the benefits of TDM and modal strategies, each strategy was reviewed for the likelihood of implementation by 2015. For TDM strategies, it will be difficult to implement the General Tolls by 2015 and uncertain if it would ever be implemented. Therefore the traffic reductions attributed to General Tolls are not considered in this review. For modal strategies, the implementation of Corridor Rail (M1) and High Speed Rail (M2) are unlikely by 2015; so for the purposes of this review M1 and M2 are not considered. The combined reduction in traffic for the remaining TDM and modal strategies is 14.1%.

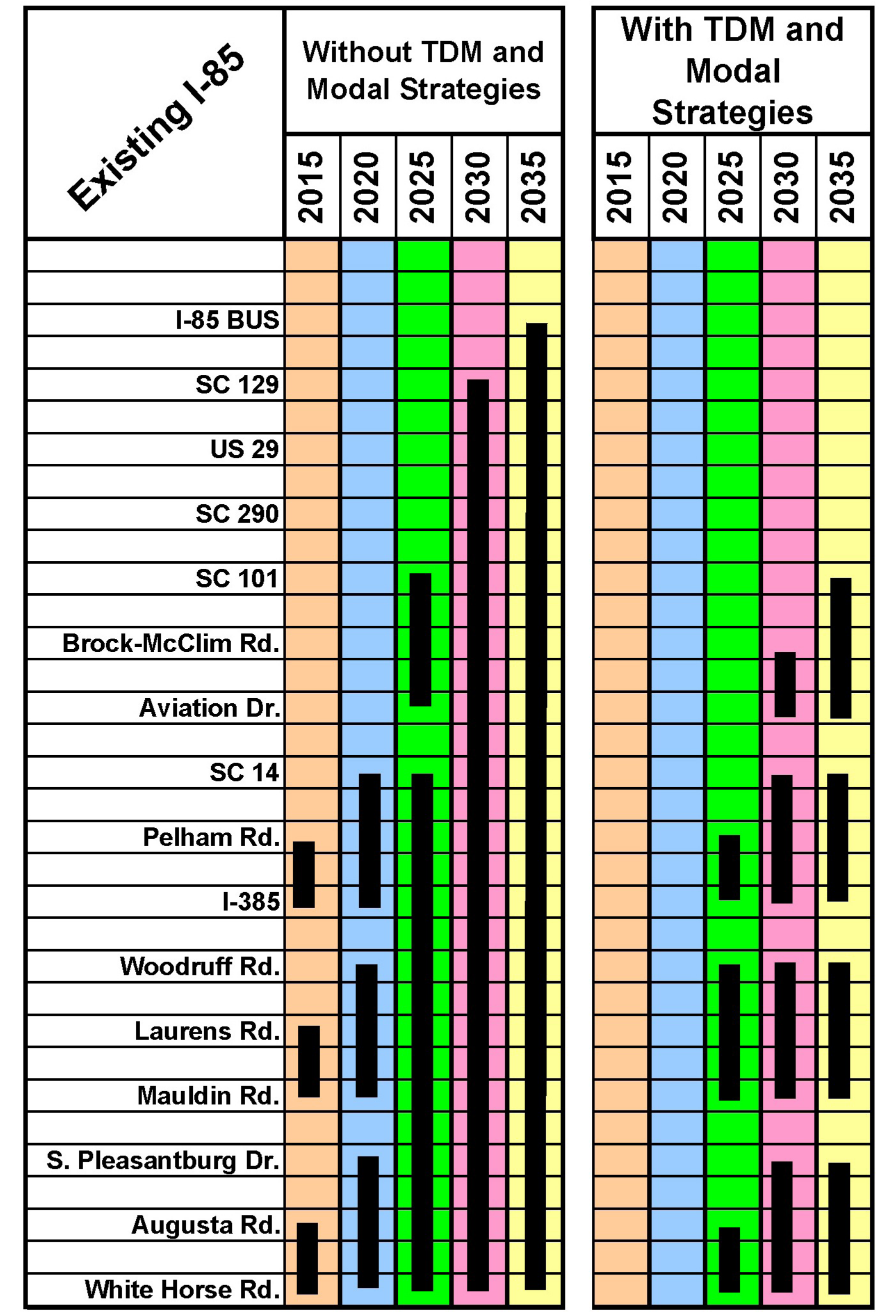
The traffic reduction based on the TDM and modal strategies was applied to the six-lane freeway model. The HCM Basic Freeway Equation was used to evaluate the widening needs along the corridor with the implementation of TDM and modal strategies based on the five-year incremental traffic projections. The results of this evaluation are shown in Exhibit 80 under the headings "With TDM and Modal." Implementation of TDM and modal strategies have the potential to delay widening needs by ten years or more. Many of the widening needs are delayed beyond the 2035 study year. While not specifically modeled, the 10-year delay in widening needs results from an approximate 15% reduction in traffic by implementing the TDM and modal strategies. This is a rate of approximately 8 months for each 1% decrease in traffic. The estimated traffic reductions are conservative and could be increased within an aggressive implementation effort for those items such as Park and Ride and Ride Sharing. If these efforts produced an additional 7% reduction in projected traffic, the need for additional capacity could be delayed another 5 years. This would delay the widening needs for all but the segment between I-385 and SC 14 to beyond the study year of 2035. Implementation of TDM and modal strategies significantly shift the time by which widening of various segments of the six-lane freeway is needed.

Exhibit 80: TDM and Modal Impacts on Widening

Additional Northbound Lanes Needed



Additional Southbound Lanes Needed



Additional Capacity Needed

Note: The capacity needs are based on the assumption that no improvements are made in prior years.

Widening for HOV (C31) or HOT (C32) Lanes

HOV or HOT lanes are discussed in detail in Chapter 9 as a means of managing the utilization of the freeway lanes. As noted in the previous discussion, converting an existing lane to an HOV or HOT lane is not practical, as restricting the use of two of the existing six travel lanes will increase congestion in the remaining four general use lanes. Implementation of HOV or HOT lanes will require the addition of at least one lane in both the northbound and southbound directions, thus creating an eight-lane freeway.

Widening for the implementation of HOV or HOT lanes is somewhat different than the widening previously discussed. Widening in relatively short segments as the need for additional capacity increases is not conducive to the effective operation of HOV or HOT lanes. Implementation of HOV or HOT lanes requires widening in relatively long segments or converting widened segments to HOV or HOT lanes in the future. In order to compare the effectiveness of HOV and HOT lanes in relieving congestion along I-85, two VISSIM models were run, the 2035 HOV model and the 2035 HOT model. These evaluation models simulate the implementation of HOV and HOT lanes for the full length of the corridor using one of four lanes in each direction as the HOV or HOT lane. Several congestion indicators are compared in Exhibit 81 for the 2035 No Build, 2035 4-Lane Build, 2035 HOV, and 2035 HOT simulations.

Exhibit 81: Comparison of Fourth Lane Performance

		2035 No Build	2035 4-Lane Build	2035 HOV	2035 HOT
Average Delay per vehicle (sec)	AM	409	314	378	386
	PM	581	431	487	507
Average Speed (mph)	AM	22.9	27.7	23.9	23.7
	PM	16.9	22.4	19.6	19.0
Total Travel Time NB (min)	AM	35.7	32.6	37.6	40.5
	PM	73.7	52.8	75.3	75.4
Total Travel Time SB (min)	AM	69.8	45.9	60.2	56.6
	PM	48.6	39.2	42.3	37.3

As expected, the widening models (4-Lane, HOV, and HOT) show improvement in reducing delay and increasing speed when compared to the 2035 No Build model (three lanes). However, when comparing the 4-Lane Build model (four general use lanes in each direction) to the HOV and HOT models (one restricted use lane and three general use lanes in each direction), the 4-Lane Build model shows greater effectiveness in reducing delay and increasing travel speeds.

The cost of adding a fourth lane in each direction (no other improvements) is approximately the same for each of the widening strategies; however, the HOV and HOT options require a higher initial investment as longer segments must be constructed in order to be effective. Based primarily on traffic performance, increasing the capacity of I-85 to four general use lanes in each direction is recommended as being superior to the implementation of HOV or HOT lanes.

10.2 INTERCHANGE IMPROVEMENTS

There are 15 interchanges along the I-85 corridor. The interchanges were reviewed for performance in the VISSIM model for exiting and future (2035) operating conditions. Of the 15 interchanges, three were identified as needing improvement. These are the interstate system interchange at I-85 and I-385, the interchange at US 276 (Laurens Road), and the interchange at SC 290 (E. Main Street). Improvements were identified at other interchanges, but are limited to ramp improvements which are discussed in Section 9.1 Ramps. The recommended interchange improvements are discussed in more detail below.

Interstate System-to-System Interchange at I-85 and I-385 (C11)

This interchange is a major system to system interchange within the project limits of the corridor study. The existing interchange is shown in Exhibit 82. Major reconstruction of the interchange is planned. SCDOT currently has preliminary design and environmental work underway through a separate contract. For the purposes of modeling future traffic, Alternative 4 has been included in the 2035 VISSIM model in order to simulate the anticipated future geometric design. However, the alternative included in the model is subject to change as the design is further developed and the environmental process completed.

The objective of the redesigned interchange is to improve or replace any substandard loops or ramps, to provide the required number of lanes on all ramps, and to provide adequate acceleration and deceleration lanes with appropriate weaving distances. The existing interchange includes loop ramps carrying I-385 northbound to I-85 southbound and I-85 southbound to I-385 southbound. These ramps are on the I-385 bridges over I-85 and have a double weave on the CD road under the I-385 bridges. Other problem areas within the interchange are the I-85 Southbound ramp to I-385 between Pelham Road and I-385, the I-85 northbound ramp between I-385 and Pelham Road, and the I-385 southbound off ramp at Woodruff Road weaving with the on ramp from the CD road at this same location. A number of ramps do not have adequate lanes to carry the projected traffic volumes. Major changes included in the model are the elimination of the loop ramps, development of a four-level interchange by adding elevated ramps, and CD road extension and improvements. Elevated "flyover" ramps and CD roads are proposed to replace the loop ramps and improve other interchange movements. A conceptual layout of the proposed interchange as included in the model for this study is shown in Exhibit 83. The VISSIM model for the proposed interchange concept shows improved traffic flow.

Exhibit 82: I-85 & I-385 Existing Interchange

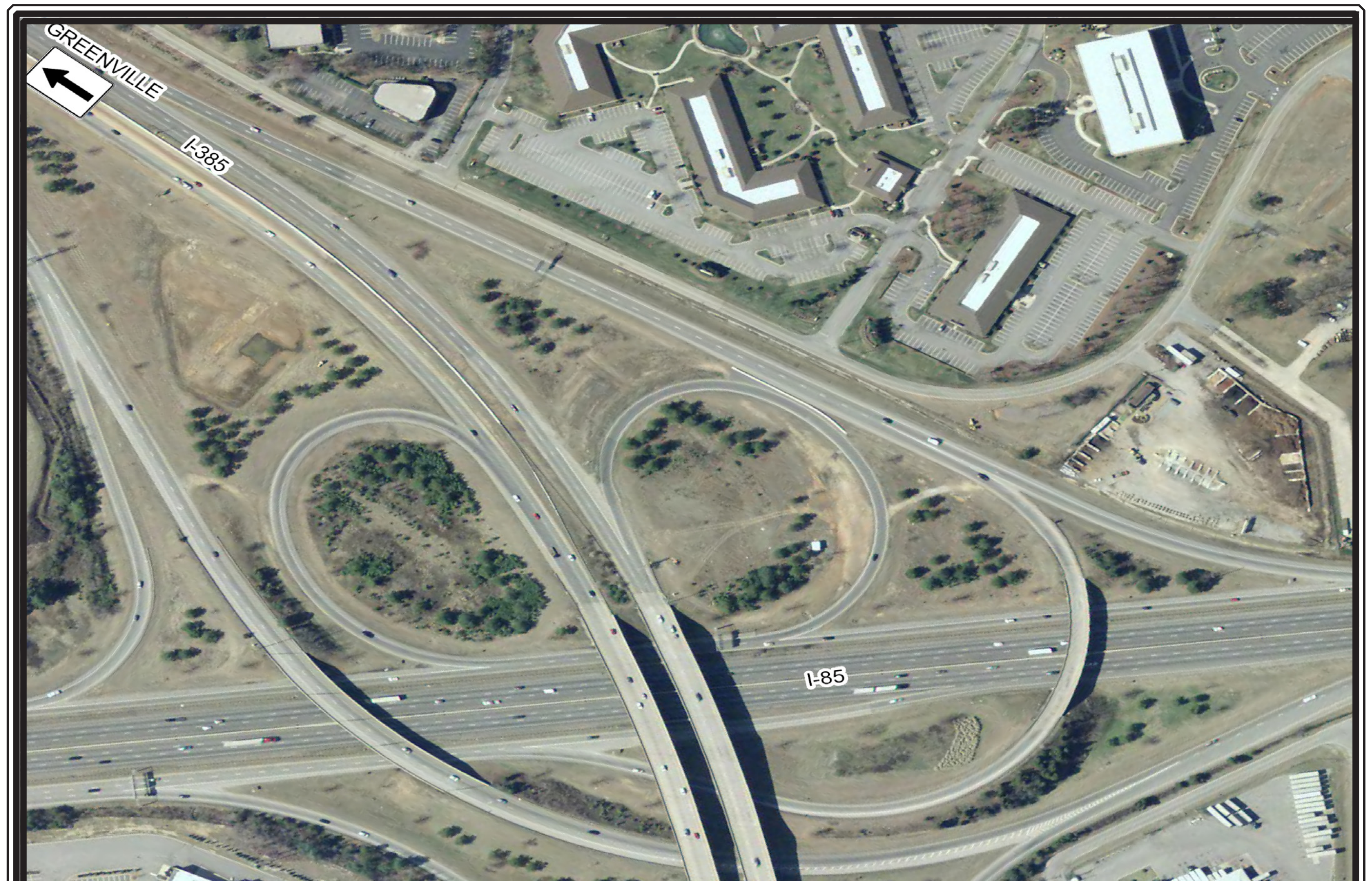
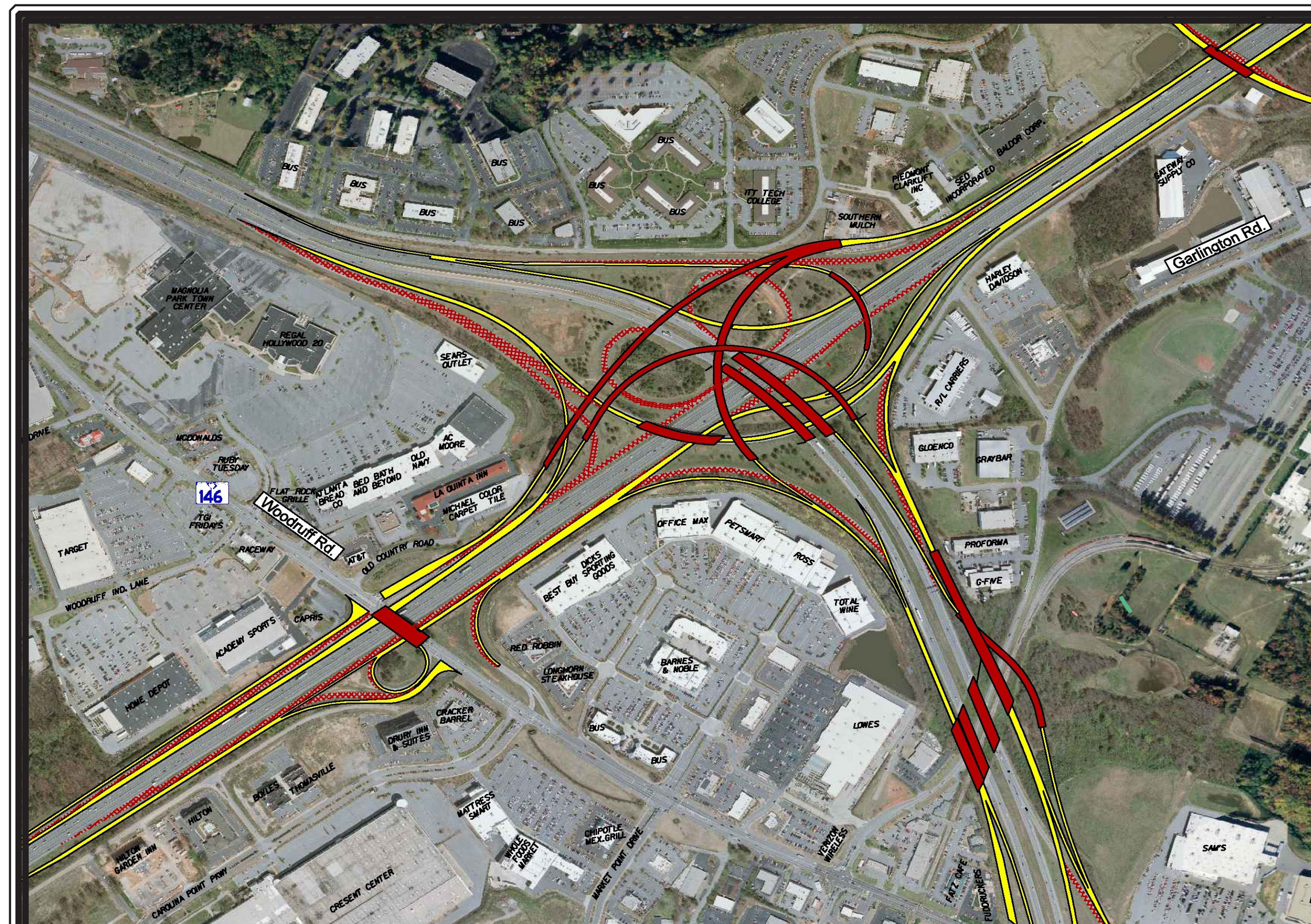


Exhibit 83: I-85 & I-385 Interchange in VISSIM Model



I-85 at US 276 (Laurens Road) (C3)

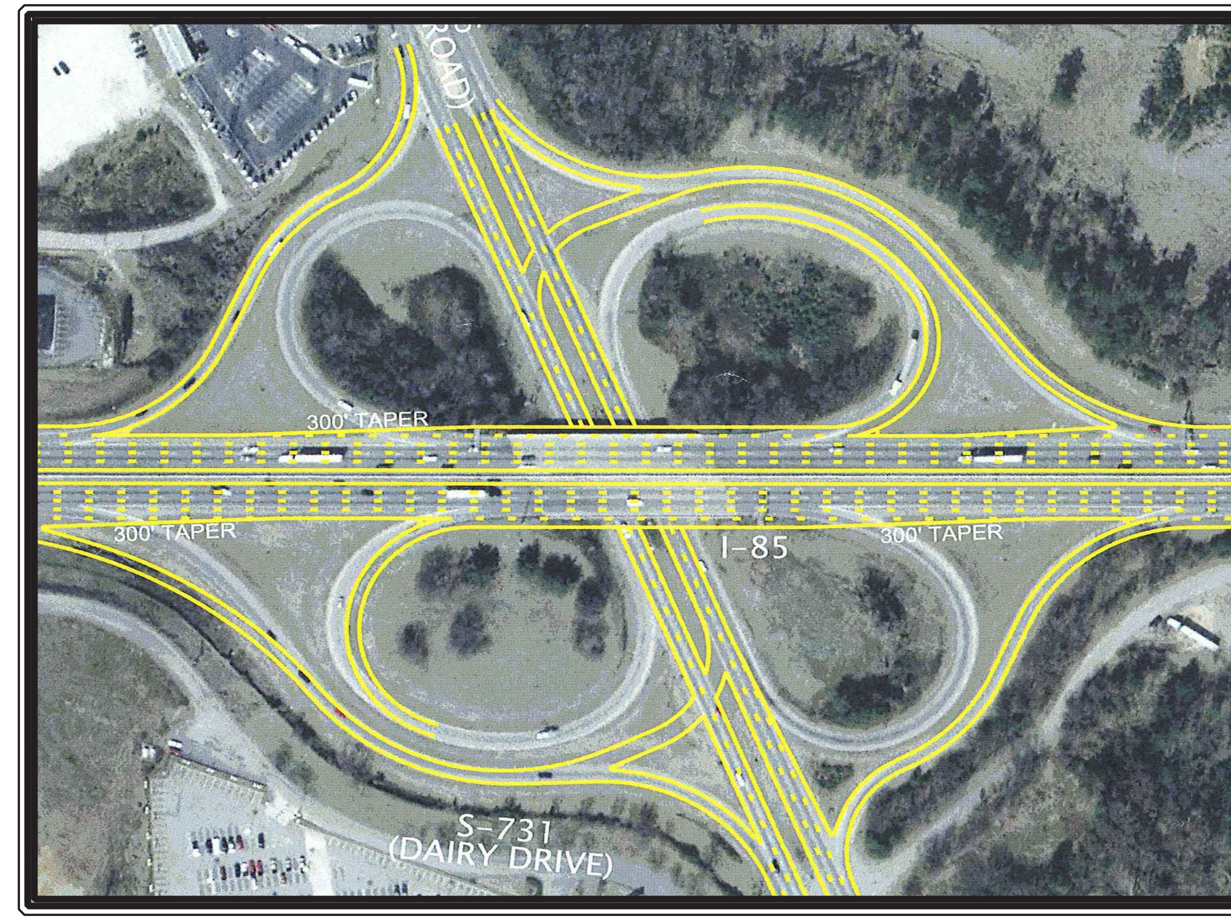
This interchange is currently a full cloverleaf design. While traffic volumes are not extremely heavy on the ramps, the high speed weave created on I-85 due to the on and off-ramps being on the bridges creates operational and safety issues. This condition exists on both the northbound and southbound lanes.

Several alternatives were considered to remove the high speed weaving condition; including constructing a separated collector distributor road and retaining the full cloverleaf design, thus moving the weave to a lower speed facility. Also considered was the concept of converting the interchange to a Single Point Urban Interchange (SPUI). Both designs would relieve the undesirable weave however cost considerations would make them impractical. The CD proposal would require significant right of way and the SPUI alternative would require raising the mainline of I-85 approximately 10 feet to accommodate the necessary additional bridge depth due to the longer spans.

A Diverging Diamond Interchange (DDI) was also considered for the Laurens Road interchange. This concept is relatively new and reduces conflict points and introduces a traffic signal on each end of the interchange. For the DDI concept traffic crosses to the opposite side of the road, thus allowing left turns onto the ramps without a conflict with opposing traffic. This concept is shown for the SC 290 interchange on the following page. At Laurens Road, the DDI interchange would occur on Laurens Road under the interstate bridges. Westbound on Laurens Road there will be about 1500 vph turning left onto the ramp to I-85 south. When Combined with the 615 vph coming from Greenville (eastbound on Laurens), there will be 2115 vehicles merging on the southbound ramp and entering I-85 in the AM peak. The merge area on the ramp will require 3 lanes for a short distance to merge the traffic into 2 lanes. The 2115 vph will require the 2 lanes to be carried onto the interstate.

A partial cloverleaf (Parclo A) is recommended and would accommodate the traffic volumes and accomplish the goal of removing the high speed weave without major bridge construction or significant additional rights of way. The loop ramp exits that carry I-85 northbound traffic toward Greenville and I-85 southbound traffic toward Mauldin would be removed. All exiting traffic for both northbound and southbound lanes would use the existing off-ramps located prior to the bridge. This will require the addition of two new traffic signals at the ramp terminals on US 276 to allow traffic to turn toward Greenville or Mauldin. The on-ramp loops carrying traffic from US 276 eastbound onto I-85 northbound and US 276 westbound traffic onto I-85 southbound would remain in service. The proposed changes to the US 276 interchange are shown in Exhibit 84.

Exhibit 84: Laurens Road Interchange Improvement



I-85 at SC 290 (East Main Street) (C11)

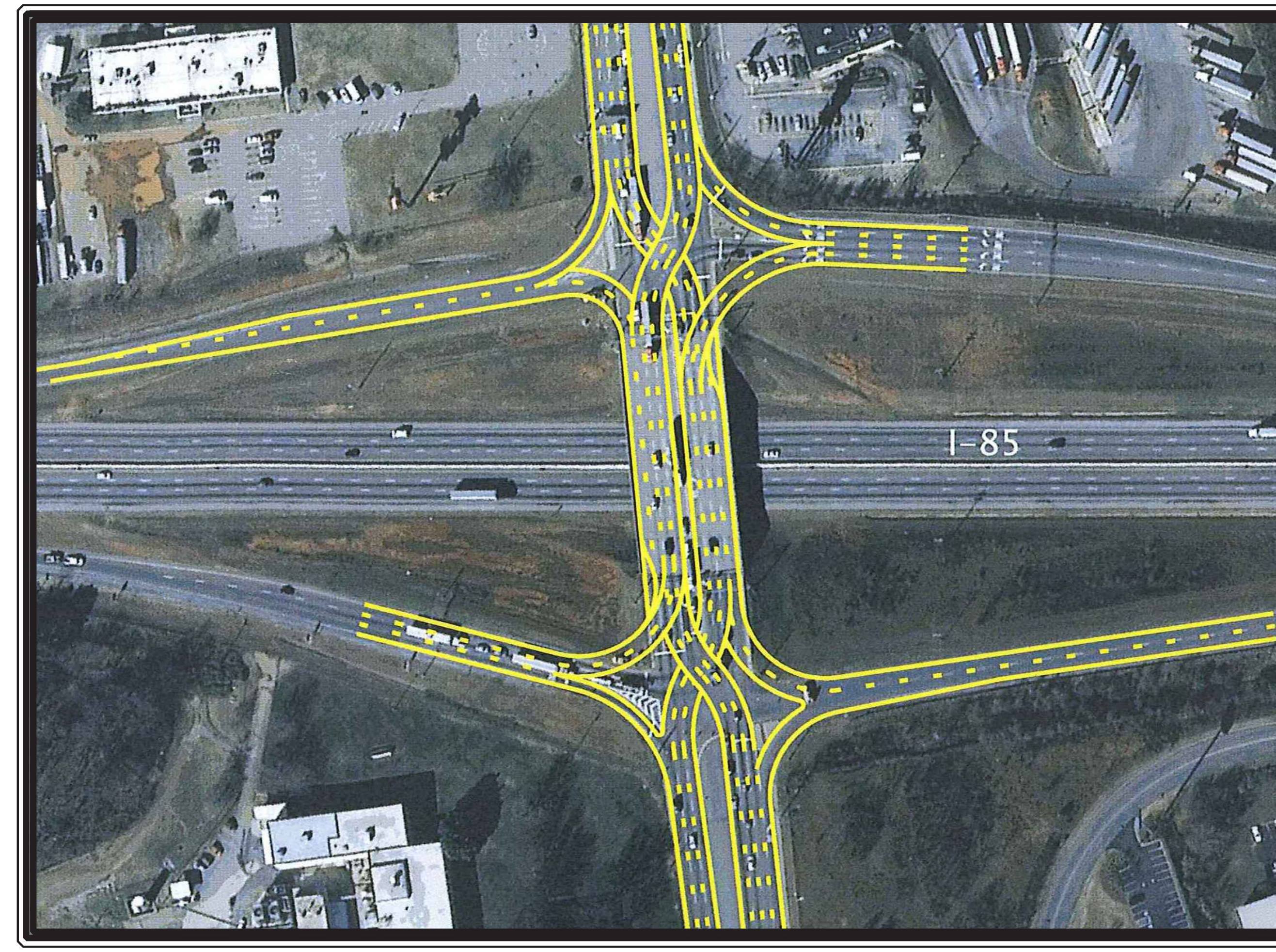
This interchange is currently a standard diamond design, with SC 290 crossing over I-85. There are currently three through lanes in each direction on SC 290, with a double left turn onto I-85 northbound ramp and a single left turn onto I-85 southbound ramp. There are several large manufacturing plants on the east side of the interchange and several large truck stops on the west side of the interchange, resulting in a large number of trucks travelling through the interchange and making left turns onto the interstate from both directions.

Several alternatives were reviewed to alleviate the traffic congestion created by the large truck volumes. One alternative was to add an additional left turn lane for SC 290 westbound turning onto I-85 southbound. This would require reducing the through lanes on SC 290 westbound to two lanes. There is excess through capacity on SC 290 making this a viable option.

Another option is to convert the interchange to a diverging diamond design. This type interchange is a relatively new concept that reduces conflict points and simplifies traffic signal phasing by crossing traffic at a traffic signal on each end of the interchange to the opposite side of the road, allowing left turns onto the ramps without a conflict with opposing traffic. This location is ideal for this type interchange due to the heavy left turning volumes and relatively low through volumes. The width of the current bridge easily accommodates the necessary lanes and only ramp revisions and channelization would be necessary to accommodate the diverging diamond.

The diverging diamond interchange is recommended as it provides a significantly greater reduction in queue lengths on the I-85 southbound off-ramp and improves the level of services on the I-85 northbound lane. The diverging diamond interchange is shown in Exhibit 85. Ramp improvements at the SC 290 interchange are recommended in Chapter 9.

Exhibit 85: SC 290 Diverging Diamond



Batesville Road Interchange Concept

A 2030 GPATS LRTP model run was performed for both No-Build (without the proposed Batesville Road interchange) and Build (with the Batesville Road interchange) scenarios to evaluate the need for the proposed Batesville Road interchange with I-85. The proposed Batesville Road interchange is located between the existing interchanges at Pelham Road and SC 14. Currently Batesville Road is located approximately 1.11 miles north of Pelham Road and 1.09 miles south of the SC 14. The study area for this particular analysis includes the I-85 mainline segment between Pelham Road and SC 14 and three cross street segments, Pelham Road, Batesville Road and SC 14. The cross streets were analyzed to the nearest signalized intersections on both sides of I-85.

The following roadway projects were included in the 2030 Build Travel Demand Model Batesville Road Interchange concept:

- Garlington Road Widening between SC 146 and Pelham Road
- Roper Mountain Road Widening between Garlington Road and Huntington Road
- Blacks Drive Widening between Roper Mountain Road and Pelham Road

The following roadways were added to the GPATS model network:

- Wrenwood Road
- Dairy Drive Connection
- N. Kings Road
- Frontage Road between SC 14 and SC 101

The 2030 daily traffic assignments at the three adjacent interchanges (i.e. Pelham Road, proposed Batesville Road and SC 14 interchanges) are shown graphically in Exhibit 86. The No-Build traffic assignments and arterial LOS were compared against the Build volumes and LOS. The No-Build results are presented on top of the Build results in all figures.

The 2030 projection along I-85 between Pelham Road and Batesville Road interchanges shows an increase of 2,900 vpd (from 71,300 to 74,200 vpd along northbound) and 1,600 vpd (from 69,600 to 71,200 vpd along southbound) in Build conditions compared to No-Build. The I-85 segments between Batesville Road and SC 14 interchanges also show an increase of 100 vpd (from 71,300 to 71,400 along northbound) and 2,000 vpd (from 69,600 to 71,600 along southbound) in the Build scenario compared to No-Build. The operational results show that the entire I-85 segment between Pelham Road and SC 14 interchanges will operate at LOS F during both 2030 Build and No-Build scenarios.

The traffic projections along Pelham Road on both sides of I-85 are essentially the same in the Build traffic conditions compared to No-Build. The Build volume projections at both segments between Old Boiling Springs Road and I-85 and between I-85 and Garlington Road show an increase of 400 vpd (from 37,900 vpd to 38,300 vpd) and a drop of 1,600 vpd (from 43,100 to 41,500 vpd), respectively compared to No-Build scenario. The LOS results along Pelham Road are LOS F in both 2030 Build and No-Build scenarios.

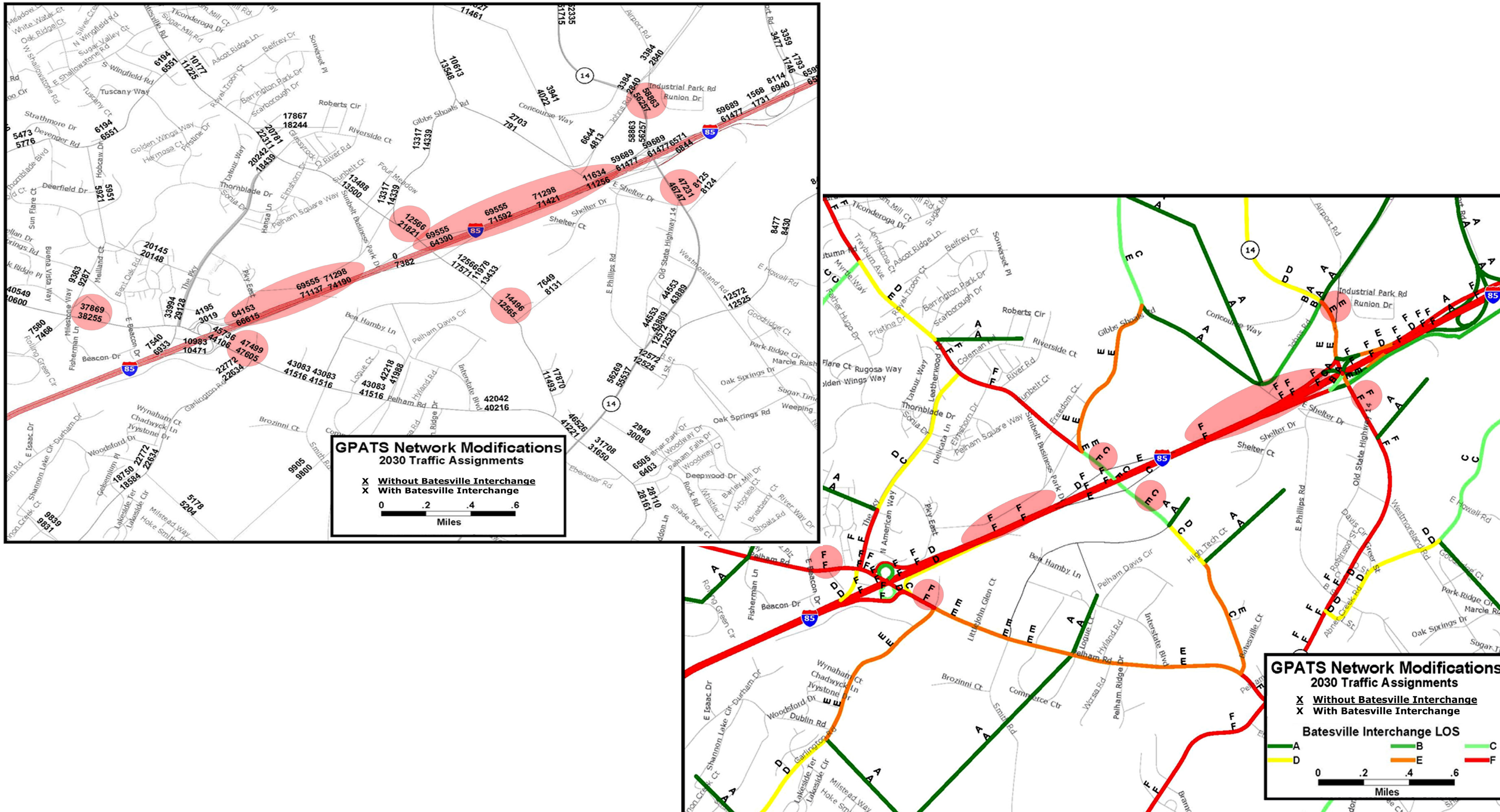
The volume projections on both sides of I-85 along Batesville Road will increase due to the addition of the proposed interchange. The segment between Gibbs Shoals Road and I-85 shows an increase of 9,200 vpd (from 12,600 to 21,800 vpd) due to the construction of the proposed interchange. Without additional improvements to Batesville Road, the operational condition will deteriorate from LOS C to LOS F. On the other side of I-85, the segment between I-85 and Smith Road also shows an increase of 5,000 vpd (from 12,600 to 17,600 vpd) in the Build scenario. The operational condition will deteriorate from LOS C to LOS E. The construction of the proposed interchange will attract more traffic along Batesville Road compared to the No-Build alternative and these additional traffic volumes will overwhelm the existing arterial capacity.

The model projections along SC 14 on both sides of I-85 show a slight decrease in the Build scenario compared to No-Build. In the Build condition, the projections between Johns Road and I-85 segment and I-85 and between East Frontage Road segment show a drop of 2,600 vpd (from 58,900 to 56,300 vpd) and 500 vpd (from 47,200 to 46,700 vpd), respectively compared to the No-Build condition. The operational condition of SC 14 on both sides of I-85 will remain unchanged at LOS E or LOS F during both No-Build and Build scenarios.

The model projections and the LOS results show that the construction of the proposed Batesville Road interchange would provide little, if any, improvement along the I-85 mainline and the three cross streets (Pelham Road, Batesville Road and SC 14) compared to No-Build condition.

Based on the limited effects of the proposed interchange on traffic on the mainline of I-85 or on the crossing routes of Pelham Road and SC 14, the construction of an interchange at Batesville Road is not recommended as an improvement strategy.

Exhibit 86: Proposed Batesville Road Interchange Traffic and LOS



10.3 INTERCHANGE RAMPS

SC 14 at I-85 SB (C17)

This proposed improvement will provide a two-lane exit ramp from I-85 southbound to the Aviation Drive/ SC 14 exit and will also lengthen the deceleration lane. Based on traffic projections, this improvement will be needed by 2025 to handle the traffic volumes and improve safety. This ramp improvement is considered a capacity improvement due to the cost.

Brockman-McClimon Road at I-85 NB (C21)

This proposed improvement will provide a two-lane exit ramp from I-85 northbound to the Brockman-McClimon Road exit. To accommodate this ramp improvement, the bridge over I-85 on Brockman-McClimon Road would be reconstructed or modified to accommodate the extra lane. Based on traffic projections, this improvement will be needed by 2035 to handle the traffic volumes and improve safety. This ramp improvement is considered a capacity improvement due to the cost.

10.4 COLLECTOR DISTRIBUTOR SYSTEMS

There are two existing CD systems. One links the interchanges at Augusta Road, Pleasantburg Drive, and Mauldin Road. The second links the Woodruff Road and I-385 interchanges. Adding CD roads that would connect the existing CD systems from north of Mauldin Road to south of Woodruff Road and extending the CD system at I-385 to Pelham Road was proposed as an improvement strategy. This proposed construction of additional CD roads was evaluated using the VISSIM model for the year 2035. The additional CD roads reduced traffic on the mainline of I-85 and attracted significant traffic volumes to the CD roads. This traffic shift created extremely high volumes entering and exiting the CD roads and very low volumes on the mainline of I-85, thus producing major congestion on the CD roads. Based on this evaluation and the adequate spacing of existing interchanges, no new CD roads are recommended.

10.5 TEMPORARY SHOULDER USE (C33)

The existing outside road shoulders from north of Pelham Road to SC 129, a distance of approximately 11.5 miles, are paved full strength and have a width of 10 feet. This full strength shoulder could be used as a temporary additional freeway lane. This use of the shoulder would be restricted to peak-hour use only or during an incident on the freeway. This strategy is being used successfully in other states and in Europe. Driver expectancy must be considered in implementing this strategy. With appropriate signing, pavement marking, and public awareness efforts, the temporary use of shoulder lanes could be implemented. This strategy would complement the Active Traffic Management strategy (OP32A).

The shoulder lanes could also be used as lanes for express bus service. A primary concern for this restricted use is safety at the exit ramps. Buses not exiting could continue forward at single lane exits, but would need to merge to the left where double lane exits are in use. This strategy would complement the development of express bus service between Greenville, the GSP Airport, and Spartanburg (M3).

Trucks should be restricted from using the temporary shoulder lane due to maintenance and safety concerns. The wheels of large trucks would track near the unsupported edge of the 10-foot paved shoulder. Studies have shown that premature pavement failure may occur if the trucks track within 18 inches of the outside pavement edge.

10.6 ENVIRONMENTAL CONCERNS

While engineering plans for these proposals remain in the conceptual stage, it is evident that substantial amounts of new right of way would be required and therefore impacts to outlying areas will occur. Exhibit 60 reflects areas of concern where more detailed studies will be needed to better determine each project's effects on these resources:

Exhibit 87: Areas of Potential Effects

Project	T/E	Cultural	Hazmat	Relocation	Recreational Resources	Noise Barriers	Streams	Wetlands
I-85 Widening						X	X	X
I-385 Interchange			X	X		X	X	X
US 276 Interchange								
SC 290 Interchange								
Interchange Ramps			X	X				

The capacity improvements shown in Exhibit 87 would not impact any known federally list endangered or threatened species, or cultural resource sites. Interchange reconstruction and ramp improvements have the potential to impact HAZMAT locations, particularly underground fuel storage tanks; this potential should be examined in the development of construction projects. A review of county and city recreational listings suggests the absence of any parks, recreational or wildlife areas in this area. However, it is anticipated that the work will impact several streams and wetland areas, including Rocky and Laurel Creeks and adjacent wetland areas. Several unnamed creeks would also be affected by these undertakings. As the footprint of the existing interstate is extended outward, the potential for impacting adjacent structures also becomes apparent with initial estimates suggesting that as many as 14 commercial and two residential structures may be affected. Additionally, detailed noise studies would have to be undertaken with several residential locations possibly warranting the construction of noise barriers.

The I-85 lane additions will likely be grouped together for environmental studies and processed under an Environmental Impact Statement. An Environmental Assessment for the I-385 interchange reconstruction is currently being developed independent of this study. Final determination of the appropriate environmental documentation of all projects will be made by the FHWA in coordination with the SCDOT.

[See Exhibit 88: Capacity Strategies Summary on next page]

Exhibit 88: Capacity Strategies Summary

LABEL	STRATEGY	RECOMMENDATION	BENEFIT	TIMING	TIMING WITH TDM/MODAL	COST (x $1000)	ASSOCIATED STRATEGIES
C1	Widening (Fourth Lane Addition)	Add 4th SB lane from Pleasantburg to White Horse	Reduces Congestion Improves Safety Reduces Travel Time	2015	2025	11,300	C24
C2		Add 4th SB lane from Laurens Road to CD exit ramp		2015	2025	13,000	C26
C4		Add 4th SB lane from Woodruff Road to Laurens Road		2015	2025	22,700	C3, C26, C27, C11, C20, C25
C5		Add 4th NB lane from to CD entrance to Laurens Road exit		2015	>2035	11,500	C3
C6		Add 4th NB lane from end of 4th lane to Pelham Road exit		2015	2025	2,400	OP5, C9, C29
C7		Add 4th SB lane from Pelham Road to CD exit to I-385/Woodruff		2015	2025	13,000	OP6, C11
C8		Add 4th NB lane from Pelham Road entrance ramp to SC 14 exit		2015	2025	13,200	OP4, OP9, C14, C18, C29
C9		Add 4th SB lane from SC 14 entrance ramp to Pelham Road exit		2015	2030	10,400	OP6, OP10
C12		Add 4th SB lane from CD exit near Mauldin Road to Pleasantburg		2025	>2035	2,400	C1, C2
C13		Add 4th SB lane within Pelham Road interchange		2025	2030	4,800	C7, C9
C14		Add 4th NB lane within Pelham Road interchange		2025	2035	4,800	C6, C8
C15		Add 4th NB lane from SC 14 entrance ramp to SC 129		2025	2035	74,200	C18, C22, C21
C16		Add 4th SB lane from SC 101 entrance ramp to SC 14		2025	2030	19,700	C19, C9, C17
C18		Add 4th NB lane from SC 14 to SC 14/Aviation Drive entrance ramp		2030	2035	6,300	C8, C15
C19		Add 4th SB lane from I-85 Bus to SC 101		2030	>2035	47,700	C16
C20		Add 4th NB lane from Laurens Road exit to Woodruff/I-385 CD		2035	>2035	14,700	C5, OP3
C23		Add 4th NB lane from I-85 Bus to I-26 exit		2035	>2035	7,800	C22
C22	Widening (Fifth Lane Addition)	Add 5th NB lane from SC 129 to I-85 Bus		2025	2035	5,300	C23, C15
C24		Add 5th SB lane from Augusta Road entrance ramp to White Horse Road exit		2035	>2035	6,500	C1
C25		Add 5th NB lane from CD entrance ramp to Laurens Road exit		2035	>2035	9,600	C5
C26		Add 5th SB lane from Laurens Road entrance ramp to CD exit ramp		2035	>2035	9,600	C2, C4
C27		Add 5th SB lane from Woodruff Road exit to Laurens Road entrance ramp		2035	>2035	11,000	C4
C28		Add 5th SB lane from SC 14 entrance ramp to I-385 exit		2030	>2035	22,100	OP10, C9, OP6
C29		Add 5th NB lane from Pelham Road exit ramp to SC 14 exit ramp		2030	>2035	14,600	OP5, C6, C8
C30		Add 5th NB lane from SC 101 entrance ramp to SC 290 exit ramp		2035	>2035	10,600	OP7, C15
C3	Interchange Improvements	Convert Laurens Road Interchange to a Parclo A	Reduces Congestion Improves Safety	2015	-	8,000	C4, C5, C20
C10		Convert SC 290 Interchange to a DDI		2015	-	1,300	OP7, OP8, OP20
C11		Reconstruct I-385 Interchange		2020	-	240,000[2]	OP3, C4, C7, OP4
C17	Ramp Improvements	Construct SB 2-lane exit ramp at SC 14/Aviation Drive, lengthen deceleration lane	Reduces Congestion Improves Safety Reduces Travel Time	2025	-	8,600	C16
C21		Construct NB 2-lane exit ramp at Brockman-McClimon Road		2035	-	6,500	C15
C31	Widening (HOV or HOT)	Construct HOV Lane Only	Reduces Travel Time	2035	2035	255,000[1]	
C32		Construct HOT Lane Only	Reduces Congestion Encourages Ride Sharing Generates Revenue	2035	2035	255,000[1]	M3, OP32A
C33	Temporary Shoulder Use	Use full strength shoulders as temporary lane	Reduces Congestion Supports Express Bus Service Provides Capacity	2013	2013	57	OP32A
					TOTAL FOR CAPACITY STRATEGIES	**$393,657**	

[1]Construction cost of HOV or HOT lanes is included in other capacity strategies and is not included in the total.
[2]Construction cost of I-385 interchange is not included in the total as funding is established under a current project.

Chapter 11: Evaluation and Recommendation of Improvement Strategies

The various **TDM, modal, operational, and capacity strategies** have been described in Chapters 7 through 10. The purpose of this chapter is to bring a relative measure of effectiveness to these various strategies and to organize the strategies in such a way that effective and cost efficient improvements can be easily identified. The strategies are organized into tables that compare and present the various strategies in a manner that allows for selection of projects based on effectiveness and cost. The tables present measures of effectiveness, suitability and benefit, and project costs. The resulting "cafeteria" list of potential projects provides the tools needed for transportation agencies and transportation providers to make decisions on how to best improve I-85 between Greenville and Spartanburg while making the best use of limited funds. An explanation of each of the various tables follows with the tables presented in the following pages.

Measures of Effectiveness (MOE)

A wide array of measures is included in the Exhibits 89-92 in order to evaluate the wide variety of strategies. Many of the measures are based on data generated through the VISSIM model. A number of other measures are more value oriented and less rigorous, but meaningful in the comparison of strategies within the four categories of TDM, modal, operational, and capacity.

The VISSIM output values were derived from the data resulting from the various evaluation models. In each table, results from the evaluation models are compared to the results of the 2035 No Build model with only the change for each measure given. The resulting values are distributed to the various strategies on the basis of each strategy's contribution to the overall model results. Each strategy (or group of like strategies) is also evaluated based on value measures which consider support for other modes of transportation, contribution to safety, potential environmental impacts, livability, and feasibility of implementation.

Suitability and Benefit

Each strategy is evaluated on its suitability for the I-85 corridor and its potential benefits to traffic if implemented (see Exhibits 93-96). Suitability is a consideration of the cost, time, environmental impacts, and potential obstacles to implementation along with compatibility within the transportation corridor. Suitability is assigned from A to D with A being the most suitable. Benefits include the considerations of traffic (or traffic growth) reduction, safety, support for other modes of transportation, and environmental friendliness. Benefits are assigned from 1 to 3 with 1 being the most beneficial.

Based on these two attributes, each strategy is placed in the table. The table is divided into zones of priority based on the combination of suitability and benefits. The "green" zone indicates projects with a higher priority for implementation based on suitability and benefit. The "blue" and "white" zones indicate strategies of medium and low priority, respectively. Strategies in the "red" zone have a high potential for difficulty in implementing. These difficulties may be cost, right-of-way impacts, or compatibility within the corridor.

Cost to Benefit

The Estimated Cost to Benefit Table (Exhibit 97) groups the strategies into ranges of cost and potential to improve traffic conditions on I-85. This table allows an easy way to compare potential projects based on the anticipated availability of funds and the potential to improve traffic. For example, if the anticipated budget is less than ten million dollars, project selection would begin in the first column of projects having a cost range of zero to $10 million.

Strategy Implementation

Implementation of the various strategies for operational and capacity improvements will require construction on I-85. As demonstrated in Chapter 10, the implementation of **TDM and modal strategies can delay or eliminate the need for adding capacity (lanes)**. Exhibit 98 shows the implementation of all TDM, modal, operational, and capacity strategies by year. In this table, a number of the capacity strategies for adding lanes have been eliminated or delayed based on the implementation of TDM and modal strategies.

Exhibit 99 includes only operational and capacity strategies without the benefit of implementing TDM and modal strategies. This table is included for comparison purposes only and **demonstrates the need to implement TDM and modal strategies** when compared to Exhibit 98. The positive impact of TDM and modal strategies can be seen in the reduced cost associated with the elimination of a number of expensive capacity strategies. Conversely, the financial impact of failing to implement TDM and modal strategies is demonstrated in the additional capacity strategies and higher costs shown in Exhibit 99. The groupings within the charts link strategies that are dependent and/or similar in location along the highway or in time of implementation.

Exhibit 89: Measures of Effectiveness: Travel Demand Management

Project Evaluation Factor	Performance Measure		2035 No Build	2035 No Build with TDM Change	Travel Demand Management Strategies							
					Travel Information Advisory Service - OH VMS	Travel Information Advisory Service - SCDOT Website	511 Service	Public Outreach and Education	Freight Trip Planning/ Scheduling	Transit Oriented Development	Integrated Corridor Management	General Toll
VISSIM OUTPUT	Freeway: Total Travel Time (mins)	AM	105.5	1.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.4
		PM	122.3	-5.9	0.0	0.0	0.0	-0.1	0.0	-0.1	0.0	-1.4
	Freeway: Average Travel Speed (mph)	AM	29.35	-0.47	0.00	0.00	0.00	-0.01	0.00	0.00	0.00	-0.11
		PM	25.32	1.28	0.01	0.00	0.00	0.03	0.01	0.01	0.00	0.29
	Freeway: Average Density (vpmpl)	AM	43.81	-1.56	-0.01	0.00	0.00	-0.03	-0.01	-0.02	0.00	-0.36
		PM	43.69	-6.38	-0.03	-0.01	-0.01	-0.13	-0.03	-0.07	-0.01	-1.46
	Intersection: Total Average Delay(s)	AM	3390	-257	-1	-1	-1	-5	-1	-3	-1	-59
		PM	3783	-37	0	0	0	-1	0	0	0	-9
	Network: Average Travel Speed (mph)	AM	22.87	0.28	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.06
		PM	16.85	1.09	0.00	0.00	0.00	0.02	0.00	0.01	0.00	0.25
	Network: Average Delay/Vehicle(s)	AM	408.79	-11.92	-0.05	-0.02	-0.02	-0.25	-0.05	-0.12	-0.02	-2.73
		PM	580.54	-45.38	-0.19	-0.09	-0.09	-0.95	-0.19	-0.47	-0.09	-10.40
	Network: Average Emissions (g/hr)	AM	2,608,429	-115161	-480	-240	-240	-2399	-480	-1200	-240	-26391
		PM	2,819,339	-175726	-732	-366	-366	-3661	-732	-1830	-366	-40271
	Network: Total Fuel Consumption (gal/hour)	AM	26,163	-1155	-5	-2	-2	-24	-5	-12	-2	-265
		PM	28,278	-1762	-7	-4	-4	-37	-7	-18	-4	-404
Congestion Reduction	Peak Hour Vehicle Reduction (Mode Shift/ Peak Spread) %	AM		3.6	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.8
		PM		14.6	0.1	0.0	0.0	0.3	0.1	0.2	0.0	3.3
	Extension of Existing Infrastructure Lifespan (years)				No	No	No	Yes	Yes	Yes	Yes	Yes
Safety	Reduced Crash Rates/Reduced Incident Times				Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Environmental	Impact to Natural Features/ Wetlands				Low	Low	Low	Low	Low	Low	Low	Low
Livability	Promotes Connectivity/Transport Choices				Low	Low	Medium	High	Low	High	Low	Medium
Constructability & Feasibility	Impacts on ROW				Low	Low	Low	Low	Low	Low	Low	Low

Exhibit 90: Measures of Effectiveness: Modal Strategies

Project Evaluation Factor	Performance Measure		2035 No Build	2035 No Build with Modal Change	Travel Demand Management Strategies										
					Commuter Rail	High Speed Rail	Express Bus	Bus Rapid Transit	Ride Sharing Programs	Park & Ride Facilities	Taxi & Limousine to GSP	Bicycle & Pedestrian Opportunities	Truck to Train Freight Opportunities	Truck Parking Areas	Transit Service
VISSIM OUTPUT	Freeway: Total Travel Time (mins)	AM	105.5	1.7	0.3	0.3	0.2	0.0	0.2	0.6	-	-	0.1	0.2	0.0
		PM	122.3	-5.9	-1.1	-1.1	-0.7	-.01	-0.8	-1.9	-	-	-0.4	-0.6	-0.1
	Freeway: Average Travel Speed (mph)	AM	29.35	-0.47	-0.09	-0.09	-0.06	-0.01	-0.06	-0.15	-	-	-0.03	-0.05	-0.01
		PM	25.32	1.28	0.24	0.23	0.16	0.02	0.17	0.42	-	-	0.09	0.13	0.02
	Freeway: Average Density (vpmpl)	AM	43.81	-1.56	-0.29	-0.29	-0.19	-0.02	-0.20	-0.51	-	-	-0.11	-0.15	-0.02
		PM	43.69	-6.38	-1.20	-1.17	-0.79	-0.08	-0.83	-2.08	-	-	-0.46	-0.63	-0.08
	Intersection: Total Average Delay(s)	AM	3390	-257	-48	-47	-32	-3	-34	-84	-	-	-18	-25	-3
		PM	3783	-37	-7	-7	-5	0	-5	-12	-	-	-3	-4	0
	Network: Average Travel Speed (mph)	AM	22.87	0.28	0.05	0.05	0.03	0.00	0.04	0.09	-	-	0.02	0.03	0.00
		PM	16.85	1.09	0.20	0.20	0.14	0.01	0.14	0.36	-	-	0.08	0.11	0.01
	Network: Average Delay/Vehicle(s)	AM	408.79	-11.92	-2.24	-2.18	-1.48	-0.16	-1.56	-3.90	-	-	-0.86	-1.17	-0.16
		PM	580.54	-45.38	-8.52	-8.30	-5.64	-0.59	-5.93	-14.83	-	-	-3.26	-4.45	-0.59
	Network: Average Emissions (g/hr)	AM	2,608,429	-115161	-21632	-21075	-14301.04	-1505	-15054	-37634	-	-	-8280	-11290	-1505
		PM	2,819,339	-175726	-33009	-32159	-21822	-2297	-22971	-57427	-	-	-12634	-17228	-2297
	Network: Total Fuel Consumption (gal/hour)	AM	26,163	-1155	-217	-211	-143	-15	-151	-377	-	-	-83	-113	-15
		PM	28,278	-1762	-331	-322	-219	-23	-230	-576	-	-	-127	-173	-23
Congestion Reduction	Peak Hour Vehicle Reduction (Mode Shift/Peak Spread)			3.6	3.6	0.7	0.4	0.0	0.5	1.2	-	-	1.0	1.4	0.2
	Extension of Existing Infrastructure Lifespan (years)				Yes	Yes	Yes	Yes	Yes	Yes	No	No	Yes	No	Yes
Safety	Reduced Crash Rates/ Reduced Incident Times				Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Environmental	Impact to Natural Features/ Wetlands				High	Medium	Low	Low	Low	Medium	Low	Low	Low	Low	Low
Livability	Promotes Connectivity/ Transport Choices				High	Medium	High	High	High	High	High	High	Low	Low	High
Constructability & Feasibility	Impacts on ROW				High	High	Low	Low	Low	Medium	Low	Low	Low	Medium	Low

Exhibit 91: Measures of Effectiveness: Operational Strategies

Project Evaluation Factor	Performance Measure		2035 No Build	2035 3 Lane Operational Improvement	Operational Strategies								
					Interstate Ramps	Signing		Parallel Routes	ITS - Traffic Cameras & Enhanced Management System	Safety			
						Mainline	Crossing Routes			Enhanced Incident responders	Accident Investigation Areas	Visual Barriers	Median & Shoulder Treatment
VISSIM OUTPUT	Freeway: Total Travel Time (mins)	AM	105.5	-12.1	-7.9	-0.4	-0.1	-0.6	-1.2	-0.2	-0.5	-0.7	-0.5
		PM	122.3	-9.4	-6.1	-0.3	-0.1	-0.5	-0.9	-0.2	-0.4	-0.6	-0.4
	Freeway: Average Travel Speed (mph)	AM	29.35	3.80	2.5	0.1	0.0	0.2	0.4	0.1	0.2	0.2	0.2
		PM	25.32	2.10	1.4	0.1	0.0	0.1	0.2	0.0	0.1	0.1	0.1
	Freeway: Average Density (vpmpl)	AM	43.72	-3.15	-2.0	-0.1	0.0	-0.2	-0.3	-0.1	-0.1	-0.2	-0.1
		PM	43.69	-6.94	-4.5	-0.2	-0.1	-0.3	-0.7	-0.1	-0.3	-0.4	-0.3
	Intersection: Total Average Delay(s)	AM	3,390.0	203.6	152.7	6.1	2.0	6.1	20.4	4.1	8.1	4.1	8.1
		PM	3,783.4	-199.9	-149.9	-6.0	-2.0	-6.0	-20.0	-4.0	-8.0	-4.0	-8.0
	Network: Average Travel Speed (mph)	AM	22.87	2.19	1.5	0.0		0.1	0.2	0.0	0.1	0.1	0.1
		PM	16.85	1.42	1.0	0.0		0.0	0.1	0.0	0.1	0.1	0.1
	Network: Average Delay/Vehicle(s)	AM	408.79	-46.65	-32.7	-0.5		-1.4	-4.7	-0.9	-1.9	-1.9	-1.9
		PM	580.54	-42.53	-29.8	-0.4		-1.3	-4.3	-0.9	-1.7	-1.7	-1.7
	Network: Average Emissions (g/hr)	AM	2,608,429	5,152	3761.0	51.5		154.6	412.2	103.0	206.1	206.1	206.1
		PM	2,819,339	-101,144	-73835.1	-1011.4		-3034.3	-8091.5	-2022.9	-4045.8	-4045.8	-4045.8
	Network: Total Fuel Consumption (gal/hour)	AM	26,163	51	37.2	0.5		1.5	4.1	1.0	2.0	2.0	2.0
		PM	28,278	1,014	740.2	10.1		30.4	81.1	20.3	40.6	40.6	40.6
Congestion Reduction	Peak Hour Vehicle Reduction (Mode Shift/Peak Spread)				No	No	No	Yes	Yes	No	No	No	No
	Extension of Existing Infrastructure Lifespan (years)				No	No	No	Yes	No	No	No	No	No
Safety	Reduced Crash Rates/ Reduced Incident Times				Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Environmental	Impact to Natural Features/ Wetlands				Medium	Low	Low	Medium	Low	Low	Low	Low	Low
Livability	Promotes Connectivity/ Transport Choices				Low	Low	Low	High	Medium	Low	Low	Low	Low
Constructability & Feasibility	Impacts on ROW				Medium	Low	Low	Medium	Low	Low	Low	Low	Low

Exhibit 92: Measures of Effectiveness: Capacity Strategies

Project Evaluation Factor	Performance Measure		2035 No Build	Capacity Improvement Strategies		
				2035 4-Lane Change	2035 HOV Change	2035 HOT Change
VISSIM OUTPUT	Freeway: Total Travel Time (mins)	AM	105.5	-22.7	-7.7	-8.4
		PM	122.3	-30.3	-4.7	-9.6
	Freeway: Average Travel Speed (mph)	AM	29.35	8.04	2.31	2.54
		PM	25.32	8.33	1.01	2.15
	Freeway: Average Density (vpmpl)	AM	43.81	-10.66	-8.28	-1.12
		PM	43.69	-13.78	-13.38	-4.27
	Intersection: Total Average Delay(s)	AM	3,390.0	146.9	294.7	690.9
		PM	3,783.4	382.1	-41.9	68.9
	Network: Average Travel Speed (mph)	AM	22.87	2.81	1.02	0.8
		PM	16.85	5.64	2.79	2.2
	Network: Average Delay/Vehicle(s)	AM	408.79	-56.19	-30.65	-22.18
		PM	580.54	-149.78	-93.52	-73.58
	Network: Average Emissions (g/hr)	AM	2,608,429	-444,921	-61,750	57,703
		PM	2,819,339	-174,164	-171,432	-71,452
	Network: Total Fuel Consumption (gal/hour)	AM	26,163	-451	-620	579
		PM	28,278	-1,747	-1,719	716
Congestion Reduction	Peak Hour Vehicle Reduction (Mode Shift/Peak Spread)			No	No	No
	Extension of Existing Infrastructure Lifespan (years)			No	No	No
Safety	Reduced Crash Rates/ Reduced Incident Times			High	Low	Low
Environmental	Impact to Natural Features/ Wetlands			High	Low	Low
Livability	Promotes Connectivity/ Transport Choices			Low	Low	Low
Constructability & Feasibility	Impacts on ROW			High	High	High

Exhibit 93: Travel Demand Management

BENEFIT	SUITABILITY			
	A	B	C	D
1	**PUBLIC OUTREACH & EDUCATION** • (TDM4) Partner with major industries to make opportunities known to employees and identify new opportunities to meet employers' and employees' needs	**511 SERVICE** • (TDM3) Add referral to SCDOT website & continue to improve customer friendliness **INTEGRATED CORRIDOR MANAGEMENT (ICM)** • (TDM7) Initiate ICM Focus Group •		
2	**TRAVEL INFORMATION & ADVISORY SERVICE** • (TDM1) Place additional overhead variable message signs over: ◻ NBL between I-385 & Pelham Road ◻ SBL between Woodruff Road & Laurens Road ◻ NBL between SC 101 & SC 290 ◻ SBL between SC 290 & SC 101 ◻ NBL south of US 25 • (TDM2) Add to SCDOT website ◻ Information on Park & Ride ◻ Information on transit opportunities ◻ Information on Ride Share Programs	**FREIGHT TRIP PLANNING/SCHEDULING** • (TDM5) Partner with major freight generators & providers to identify & develop opportunities to shift freight traffic to off-peak		
3	**TRANSIT ORIENTED DEVELOPMENT (TOD)** • (TDM6) Encourage local planning agencies to consider regulations that favor TOD			

Suitability: A (High) - D (Low)
Benefits: 1 (High) - 3 (Low)

High Priority to Implement	Medium Priority to Implement	Low Priority to Implement	Very Difficult to Implement

Exhibit 94: Modal

<table>
<tr><th rowspan="2">Benefit</th><th colspan="4">Suitability</th></tr>
<tr><th>A</th><th>B</th><th>C</th><th>D</th></tr>
<tr><td>1</td><td><u>(M3) Express Bus Service</u>
• Provide Service from Greenville to GSP Airport
• Provide Service from Spartanburg to GSP Airport
• Use I-85 Shoulders for Bus Lane, Improve as Needed
<u>(M5) Ride Sharing Program</u>
• (M5) Partner with major employers to develop programs & educate employees on modal opportunities
<u>(M6) Park & Ride Facilities</u>
Develop Park & Ride facilities at the following locations:
□ Augusta Road (existing transit service)
□ GSP Airport (transit service planned)
□ SC 101 (1.5 miles to transit service)
□ US 29 at I-85 (5.0 miles to transit service)
□ US 29 to Greer (transit service planned)
□ US 178 near Anderson
Develop Park & Ride website to include trip planner, transit information, & bicycle & pedestrian accommodations</td><td></td><td><u>(M9) Truck to Train Freight Opportunities</u>
Encourage Norfolk Southern in development of Crescent Line (intermodal centers in Charlotte & Atlanta)</td><td><u>(M1) Commuter Rail</u>
Prepare Feasibility Study</td></tr>
<tr><td>2</td><td><u>(M10) Truck Parking Areas</u>
Develop truck parking areas at White Horse Road & SBL south of US 29
<u>(M11) Transit Service</u>
Provide bus service to Park & Ride facilities at SC 101 and at US 29</td><td><u>(M4) Bus Rapid Transit</u>
Provide Service on US 29 (a parallel route), improve signal operations to support bus transit
• Phase 1 – Service from Greenville to Greer
• Phase 2 – Services from Greer to Spartanburg
<u>(M8) Bicycle & Pedestrian Opportunities</u>
• Provide bicycle racks at all Park & Ride lots
• Provide bicycle carriers on all transit buses</td><td><u>(M2) High Speed Passenger Rail</u>
Plan for supporting infrastructure and intermodal transportation</td><td></td></tr>
<tr><td>3</td><td></td><td></td><td><u>(M7) Taxi & Limousine Service</u>
No recommendation</td><td></td></tr>
</table>

High Priority to Implement | **Medium Priority to Implement** | **Low Priority to Implement** | **Very Difficult to Implement**

Suitability: A (High) - D (Low)
Benefits: 1 (High) - 3 (Low)

Exhibit 95: Traffic Operational Improvements

<table>
<tr><th rowspan="2">BENEFIT</th><th colspan="4">SUITABILITY</th></tr>
<tr><th>A</th><th>B</th><th>C</th><th>D</th></tr>
<tr><td>1</td><td><u>LENGTHEN ACCELERATION/DECELERATION LANES</u>
• (OP2) NB & SB-Increase length of acceleration lane from loops by striping
• (OP4) SB-Lengthen deceleration lane to I-385/Woodruff Road exit
• (OP11) Lengthen NB deceleration lane & SB acceleration lane at US 29
• (OP12) Lengthen NB deceleration lane & SB acceleration lane at SC 129
<u>CONSTRUCT 2 LANE EXITS/ENTRANCE</u>
• (OP1) SB-Revise exit to I-385/Woodruff Road to 2 lanes by re-striping
• (OP5) NB-Construct 2 lane exit ramp at Pelham Road, lengthen deceleration lane
• (OP6) SB-Construct 2 lane exit ramp at Pelham Road, lengthen deceleration lane
• (OP7) NB-Construct 2 lane exit ramp at SC 290
• (OP8) SB-Construct 2 lane exit ramp at SC 290
• (OP3) NB-Construct 2 lane exit ramp at Woodruff/I-385 CD Exit, lengthen deceleration lane
<u>MAINLINE SIGNING</u>
• (OP13) SB-Overhead sign at I-385/Woodruff Road exit
• (OP14) Overhead sign I-85 SB & NB exits at Pelham Road
<u>ITS - ACTIVE TRAFFIC MANAGEMENT</u>
• (OP32A) Develop implementation plan for active traffic management
<u>CROSSING ROUTE SIGNING</u>
• (OP20) Signing for SC 290 DDI Interchange</td><td><u>ENHANCED INCIDENT RESPONDER SERVICES</u>
• (OP33) Relocate to near Brochman-McClimon Interchange
<u>OFF-ROAD CRASH INVESTIGATION</u>
• (OP34) Construct I-85 SB & NB crash investigation area</td><td></td><td></td></tr>
<tr><td>2</td><td><u>CONSTRUCT 2 LANE EXITS/ENTRANCE</u>
• (OP9) NB-Construct 2 lane exit ramp at SC 14
• (OP10) SB-Construct 2 lane acceleration lanes and ramps at SC 14
<u>MAINLINE SIGNING</u>
• (OP15) Overhead sign on I-85 NB at Brockman-McClimon Road
• (OP16) Overhead sign south of Brockman-McClimon Road for SC 14 and Airport interchanges
<u>ITS - EXISTING TRAFFIC MANAGEMENT</u>
• (OP32) Expand traffic camera coverage on I-85 and expand the incident management system to non-interstate routes
<u>SAFETY</u>
• Move the Incident Responders Operation
• Off Road Crash Investigation - One Site in each Direction
<u>MEDIAN AND SHOULDER TREATMENTS</u>
• Double Yellow Raised Pavement Markers
• (OP35) Install delineators on median barrier</td><td><u>CROSSING ROUTE SIGNING</u>
• (OP17) Six overhead signs on Pelham Road
• (OP18) Six overhead signs on US 29
• (OP19) Six overhead signs on US 276 (Laurens Road)
<u>PARALLEL ROUTES OPPORTUNITIES</u>
• (OP26) Extend frontage road from SC 14 to SC 101
• (OP23) Widen Garlington Road to 4 lanes from Garlington to Farringdon
• (OP24) Widen Roper Mountain Road to 4 lanes from Garlington to Farringdon
• (OP25) Widen Blacks Drive to 4 lanes from Pelham to Roper Mountain Road
•</td><td></td><td></td></tr>
<tr><td>3</td><td><u>ADDING VISUAL BARRIERS</u>
• (OP36) Raise median barrier height</td><td><u>PARALLEL ROUTES OPPORTUNITIES</u>
• (OP21) Connect Kings Road to Duvall Drive
• (OP22) Connect Dairy Drive to Wrenwood Drive</td><td><u>PARALLEL ROUTES OPPORTUNITIES</u>
• (OP27) Improve signals & install traffic camera along US 29
• (OP28) Improve signals & install traffic camera along SC 146/SC 296
• (OP29) Improve signals & install traffic camera along Woodruff Road, Verdae Boulevard, & Laurens Road</td><td><u>MANAGED LANES</u>
• (OP30) Convert one existing lane to HOV lane in each direction
• (OP31) Convert one existing lane to HOT lane in each direction</td></tr>
</table>

High Priority to Implement | **Medium Priority to Implement** | **Low Priority to Implement** | **Very Difficult to Implement**

Suitability: A (High) - D (Low)
Benefits: 1 (High) - 3 (Low)

Exhibit 96: Capacity Improvements

Benefit	Suitability			
	A	B	C	D
1	**Construct Lanes on I-85** • (C6) Add 4th NB lane from end of 4th lane to Pelham Road exit • (C7) Add 4th SB lane from Pelham Road to I-385/Woodruff CD exit • (C4) Add 4th SB lane Woodruff Road to Laurens Road • (C8) Add 4th NB lane from Pelham Road entrance ramp to SC 14 exit • (C9) Add 4th SB lane from SC 14 entrance ramp to Pelham Road exit • (C1) Add 4th SB lane from Pleasantburg Drive to White Horse Road • (C5) Add 4th NB lane from CD entrance to Laurens Road exit **Reconstruct Interchange** • (C11) Reconstruct I-385 Interchange	**Construct Lanes on I-85** • (C28) Add 5th SB lane from SC 14 entrance to I-385 exit • (C29) Add 5th NB lane from Pelham Road entrance ramp to SC 14 exit ramp • (C25) Add 5th NB lane from CD entrance ramp to Laurens Road exit • (C26) Add 5th SB lane from Laurens Road entrance ramp to CD exit ramp • (C27) Add 5th SB Lane from Laurens Road exit ramp to Woodruff Road entrance ramp • (C33) Temporary shoulder use		
2	**Construct Lanes on I-85** • (C2) Add 4th SB lane from Laurens Road to CD exit ramp • (C12) Add 4th SB lane from CD exit near Mauldin Road to Pleasantburg • (C13) Add 4th SB lane within Pelham Road interchange • (C14) Add 4th NB lane within Pelham Road interchange • (C16) Add 4th SB lane from SC 101 entrance ramp to SC 14 • (C17) SB-2 lane exit ramp at SC 14/Aviation Drive - lengthen deceleration lane • (C15) Add 4th NB lane from SC 14 entrance ramp to SC 129 • (C22) Add 5th NB lane from SC 129 to I-85 Bus • (C18) Add 4th NB lane SC 14 to SC 14/Aviation Drive entrance ramp • (C19) Add 4th SB lane from I-85 Business to SC 101 • (C20) Add 4th NB lane from Laurens Road exit to Woodruff Road/I-385 CD **Reconstruct Interchange** • (C10) Convert SC 290 interchange to DDI •	**Construct Lanes on I-85** • (C23) Add 4th NB lane from I-85 Business to I-26 exit ramp • (C24) Add 5th SB lane from Augusta Road entrance ramp to White Horse Road exit ramp **Interchange Improvements** • (C3) Convert Laurens Road interchange to Parclo A **Managed lanes** • (C31) Construct HOV lane only • (C32) Construct HOT lane only		
3	**Construct Lanes on I-85** • (C21) NB-2 lane exit ramp at Brochman-McClimon Road • (C30) Add 5th NB Lane from SC 101 entrance ramp to SC 290 exit ramp			

High Priority to Implement	**Medium Priority to Implement**	**Low Priority to Implement**	**Very Difficult to Implement**

Suitability: A (High) - D (Low)
Benefits: 1 (High) - 3 (Low)

Exhibit 97: Estimated Cost to Benefit Table

Benefit	Estimates Cost			
	Year	$0 - 10 Million	$10 - 100 Million	Above $100 Million
Significant Impact on reducing congestion	2012	(M5) Ride Sharing Programs (M6) Park & Ride Facilities at the following locations: □ Augusta Road (existing transit service) □ GSP Airport (transit service planned) □ SC 101 (1.5 miles to transit service) □ US 29 at I-85 (5.0 miles to transit service) □ US 29 to Greer (transit service planned) □ US 178 near Anderson □ Cleveland Street at Spartanburg • Develop Park & Ride website to include trip planner, transit information, & bicycle & pedestrian accommodations (TDM3) 511 Service - Add referral to SCDOT website & continue to improve customer friendliness (TDM4) Public Outreach & Education-Partner with major industries to make opportunities known to employees and identify new opportunities to meet employers' and employees' needs (TDM7) Initiate ICM Focus Group (2013) (OP1) SB-Revise exit to I-385/Woodruff Road to 2 lanes by re-striping (OP2) NB & SB-Increase length of acceleration lane from loops by striping (OP13) SB-Overhead sign at I-385/Woodruff Road exit (C33) Temporary Shoulder Use (OP32A) Develop implementation plan for Active Traffic Management		
	2015	(OP3) NB-2 lane exit ramp at Woodruff/I-385 CD exit - lengthen deceleration lane (OP4) SB-Lengthen deceleration lane to I-385/Woodruff Road exit (OP5) Construct 2-lane exit and ramp NB at Pelham Road, lengthen deceleration lane (OP6) Construct 2-lane exit ramp SB at Pelham Road, lengthen deceleration lane (OP8) Construct 2-lane exit ramp SB at SC 290, lengthen deceleration lane (OP7) Construct 2-lane exit ramp NB at SC 290, lengthen deceleration lane (OP11) Lengthen NB deceleration lane & SB acceleration lane at US 29 (OP12) Lengthen NB deceleration lane & SB acceleration lane at SC 129 (C6) NB-4th lane from end 4th lane to Pelham Road exit (M3) Express Bus Service □ Provide Service from Greenville to GSP Airport □ Provide Service from Spartanburg to GSP Airport □ Use I-85 Shoulders for Bus Lane, Improve as Needed (OP14) Overhead sign I-85 SB & NB exits at Pelham Road (OP20) Signing for SC 290 DDI Interchange (OP34) Construct I-85 SB & NB crash investigation area (C6) Add 4th NB lane from end of 4th lane to Pelham Road exit	(C7) SB-4th lane from Pelham Road to CD exit to I-385/Woodruff (C4) SB-4th lane Woodruff Road to Laurens Road - 2 lane exit ramp (C8) NB-4th lane from Pelham Road entrance ramp to SC 14 exit (C9) SB-4th lane from SC 14 entrance ramp to Pelham Road exit (C1) SB-4th lane from Pleasantburg Drive to White Horse Road (C2) SB-4th lane from Laurens Road to CD exit (C5) NB-4th lane from CD entrance to Laurens Road exit - 2 lane entrance ramp (M1) Commuter Rail (C1) Add 4th SB lane from Pleasantburg Drive to White Horse Road (C4) Add 4th SB lane Woodruff Road to Laurens Road (C5) Add 4th NB lane from CD entrance to Laurens Road exit (C7) Add 4th SB lane from Pelham Road to I-385/Woodruff CD exit (C8) Add 4th NB lane from Pelham Road entrance ramp to SC 14 exit (C9) Add 4th SB lane from SC 14 entrance ramp to Pelham Road exit	
	2020			(C11) Reconstruct I-385 Interchange
	2025	(C14) NB-4th lane within Pelham Road interchange (C13) SB-4th lane within Pelham Road interchange		
	2030		(C28) Add 5th SB lane from SC 14 entrance to I-385 exit (C29) Add 5th NB lane from Pelham Road entrance ramp to SC 14 exit ramp	
	2035	(C25) Add 5th NB lane from CD entrance ramp to Laurens Road exit (C26) Add 5th SB lane from Laurens Road entrance ramp to CD exit ramp	(C27) Add 5th SB Lane from Laurens Road exit ramp to Woodruff Road entrance ramp	

Exhibit 97: Estimated Cost to Benefit Table Continued

Benefit	Estimates Cost			
	Year	$0 - 10 Million	$10 - 100 Million	Above $100 Million
Moderate Impact on reducing congestion	2012	(M11) Transit Service (TDM2) Travel Information Advisory Service Add to SCDOT website □ Information on Park & Ride □ Information on transit opportunities □ Information on Ride Share Programs (TDM5) Freight Trip Planning/Scheduling Opportunities - Partner with major freight generators & providers to identify & develop opportunities to shift freight traffic to off-peak (M9) Truck to Train Freight Opportunities (OP17) Six overhead signs on Pelham Road (OP18) Six overhead signs on US 29 (2013) (OP19) Six overhead signs on US 76 (Laurens Road) (2014) (OP35) Install delineators on median barrier		
	2015	(C10) Convert SC 290 interchange to DDI (C3) Convert Laurens Road interchange to Parclo A (M4) Bus Rapid Transit - Provide Service on US 29 (a parallel route) - Phase 1 – Service from Greenville to Greer (M10) Develop truck parking areas at White Horse Road and SBL south of US 29 (TDM1) Place additional overhead variable message signs over: □ NBL between I-385 & Pelham Road □ SBL between Woodruff Road & Laurens Road □ NBL between SC 101 & SC 290 □ SBL between SC 290 & SC 101 □ NBL south of US 25 (OP3) NB-Construct 2 lane exit ramp at Woodruff/I-385 CD Exit, lengthen deceleration lane (OP15) Overhead sign on I-85 NB at for Brochman-McClimon Road (OP16) Overhead sign for Brochman-McClimon Road for SC 14 and Airport interchanges (OP26) Extend frontage road from SC 14 to SC 101 (OP32) Expand traffic camera coverage on I-85 and expand the incident management system to non-interstate routes (OP33) Relocate to near Brochman-McClimon Interchange	(C2) Add 4th SB lane from Laurens Road to CD exit ramp (OP23) Widen Garlington Road to 4 lanes from Garlington to Farringdon (OP24) Widen Roper Mountain Road to 4 lanes from Garlington to Farringdon (OP25) Widen Blacks Drive to 4 lanes from Pelham to Roper Mountain Road	(M2) High Speed Rail
	2020			
	2025	(OP9) Construct 2-lane exit rand amp NB & SB at SC 14, lengthen deceleration lane (OP10) Construct 2-lane acceleration lanes & ramps NB & SB at SC 14/Aviation Drive (C12) SB-4th lane from CD exit Mauldin Road to Pleasantburg (C17) SB-2 lane exit ramp at SC 14/Aviation Drive - lengthen deceleration lane (C22) NB-5th lane from SC 129 to I-85 Bus (M4) Bus Rapid Transit -Provide Service on US 29 (a parallel route) -Phase 2 – Services from Greer to Spartanburg (C13) Add 4th SB lane within Pelham Road interchange (C14) Add 4th NB lane within Pelham Road interchange (C16) Add 4th SB lane from SC 101 entrance ramp to SC 14 (C17) SB-2 lane exit ramp at SC 14/Aviation Drive - lengthen deceleration lane (C22) Add 5th NB lane from SC 129 to I-85 Bus	(C16) SB 4th lane from SC 101 entrance ramp to SC 14 (C15) NB-4th lane from SC 14 entrance ramp to SC 129 (C15) Add 4th NB lane from SC 14 entrance ramp to SC 129 (C22) Add 5th NB lane from SC 129 to I-85 Bus (C17) SB-2 lane exit ramp at SC 14/Aviation Drive - lengthen deceleration lane	
	2030	(C18) Add 4th NB lane SC 14 to SC 14/Aviation Drive entrance ramp	(C19) Add 4th SB lane from I-85 Business to SC 101	
	2035	(C23) NB-4th lane from I-85 to I-26 exit (C24) SB 5th Lane from Augusta Road Entrance to White Horse Road Exit (C21) NB-2 lane exit ramp at Brochman-McClimon Road/I-385 CD	(C20) Add 4th NB lane from Laurens Road exit to Woodruff Road/I-385 CD (C23) Add 4th NB lane from I-85 Business to I-26 exit ramp (C24) Add 5th SB lane from Augusta Road entrance ramp to White Horse Road exit ramp	(C32) Construct HOT lane only[2]

Exhibit 97: Estimated Cost to Benefit Table Continued

Benefit	Estimates Cost			
	Year	$0 - 10 Million	$10 - 100 Million	Above $100 Million
Little Impact on reducing congestion	2015	(TDM6) Transit Oriented Development - Encourage local planning agencies to consider regulations that favor TOD (OP21) Connect Kings Road to Duvall Drive (OP22) Connect Dairy Drive to Wrenwood Drive (OP27) Improve signals & install traffic camera along US 29 (OP28) Improve signals & install traffic camera along SC 146/SC 296 (OP29) Improve signals & install traffic camera along Woodruff Road, Verdae Boulevard, & Laurens Road (OP36) Raise median barrier height		
	2020			
	2025			
	2030			
	2035		(C30) Add 5th NB Lane from SC 101 entrance ramp to SC 290 exit ramp (OP30) Convert one existing lane to HOV lane in each direction[1] (OP31) Convert one existing lane to HOT lane in each direction[1] (C21) NB-2 lane exit ramp at Brochman-McClimon Road	(C31) Construct HOV lane only[2]

Note 1: OP30 and OP31 require the conversion of existing lanes without constructing additional lanes.
Note 2: C31 and C32 include the construction of an additional lane in each direction for the full length of the corridor. The cost of C31 and C32 could be included in the $10 to $100 million range based on the assumption that the additional lanes are added in smaller segments consistent with other capacity strategies and converted from general use to HOV or HOT use once all segments are completed.

Exhibit 98: **Project Grouping for All Strategies (including TDM & Modal)**

		Description	TDM	Modal	Operational	Capacity	Total Cost
		YEAR 2012					
	OP1	I-85/Woodruff Road CD Exit at I-85 SB (provide 2-lane exit)			$50,000		
	OP2	SC 101 Acceleration Lanes at I-85 NB and SB (lengthen acceleration lanes)			$25,000		
	OP32A	ITS - Active Traffic Management			$400,00		
		Total			$475,000		$475,000
	M2	**High Speed Passenger Rail** Plan for supporting infrastructure and intermodal transportation		N/A			
	M5	**Ride Sharing Program** Partner with major employers to develop programs and educate employees on modal opportunities		$15,000			
	M8	**Bicycle & Pedestrian Opportunities** • Provide Bicycle Racks at all Park and Ride Lots • Provide Bicycle carriers on all transit buses		Included in M6			
	M9	**Truck to Train Freight Opportunities** Encourage Norfolk Southern in development of Crescent Line (intermodal centers in Charlotte and Atlanta)		None			
		Total		$15,000			$15,000
	TDM2	**Travel Information and Advisory Service** Add to SCDOT Website: • Information on Park and Ride • Information on Transit Opportunities • Information on Ride Share Programs	$3,000				
	TDM3	**511 Service** • Add referral to SCDOT website • Continue to improve customer friendliness	$1,000				
	TDM4	**Public Outreach and Education** Partner with major industries to make opportunities known to employees and identify new opportunities to meet employers' and employees' commuting needs	$20,000				
	TDM5	**Freight Trip Planning/Scheduling** Partner with major freight generators and providers to identify and develop opportunities to shift freight traffic to off-peak hours	$10,000				
	TDM6	**Transit Oriented Development (TOD)** Encourage local planning agencies to consider regulations that favor TOD	$5,000				
		Total	$39,000				$39,000
		TOTAL - YEAR 2012	**$39,000**	**$75,000**	**$475,000**		**$589,000**
		YEAR 2015					
	TDM1	**Travel Information and Advisory Service** Place additional overhead variable message signs at: • NBL between I-385 and Pelham • SBL between Woodruff and Laurens • NBL between SC 101 and SC 290 • SBL between SC 290 and SC 101 • NBL south of US 25	$175,000 $175,000 $175,000 $175,000 $175,000				
	TDM7	**Integrated Corridor Management (ICM) - initiate ICM Focus Group**	$15,000				
		Total	$890,000				$890,000

Exhibit 98: Project Grouping for All Strategies (including TDM & Modal) Continued

		Description	TDM	Modal	Operational	Capacity	Total Cost
	M1	**Commuter Rail** Prepare Feasibility Study		$200,000			
	M3	**Express Bus Service** • Provide Service from Greenville to GSP Airport • Provide Service from Spartanburg to GSP Airport • Use I-85 shoulders for bus lane, improve as needed		$230,000 per year $350,000 per year			
	M4	**Bus Rapid Transit** Provide Service on US 29 (a parallel route), improve signal operations to support bus transit • Phase 1 - Service from Greenville to Greer • Phase 2 - Services from Greer to Spartanburg		$190,000 per year (plus upgrades of $2,700,000) $250,000 per year (plus upgrades of $2,300,000)			
	M6	**Park and Ride Facilities** Develop Park and Ride Facilities at: • Augusta Road (existing transit services) • GSP Airport (transit service planned) • SC 101 (1.5 miles to transit service) • US 29 at I-85 (5.0 miles to transit service) • US 29 at Greer (transit service planned) • US 178 near Anderson • Cleveland Street at Spartanburg Develop P&R Website to include trip planner, transit information, and bike/ pedestrian accommodations		$1,150,000 $580,000 $435,000 $725,000 $150,000 $580,000 $300,000 $10,000			
	M10	**Truck Parking Areas** Develop truck parking areas at: • White Horse Road • SBL south of US 29		$870,000 $220,000			
	M11	**Transit Service** Provide bus service to park and ride facilities at SC 101 and at US 29		$15,000 per year (SC101) $45,000 per year (US 29)			
		Total		$11,360,000			$11,360,000
	OP4	I-385/Woodruff CD Exit at I-85 SB (lengthen deceleration lane)			$960,286		
	OP5	Pelham Road Exit at I-85 NB (construct 2-lane exit)			$2,880,858		
		Lengthen deceleration lane			$960,286		
	OP6	Pelham Road Exit at I-85 SB (construct 2-lane exit and ramp)			$2,880,858		
		Lengthen deceleration lane			$960,286		
	C6	Add 4th NB lane from end 4th lane to Pelham Road exit				$2,400,715	
	C7	Add 4th SB 4th lane from Pelham Road to CD exit to I-385/Woodruff (2020)				$12,963,861	
	C33	Temporary Shoulder Use				$57,000	
		Total			$8,642,574	$15,421,576	$24,064,150
	C5	Add 4th NB lane from CD entrance to Laurens Road exit (2035)				$9,602,860	
		2-lane CD entrance ramp and 2-lane exit ramp (2015)				$1,920,572	
		CD Bridge Reedy River				$676,200	
	OP3	I-385/Woodruff CD Exit at I-85 NB (construct 2-lane exit ramp)			$2,880,858		
		Lengthen deceleration lane			$960,286		
		Total			$3,841,144	$12,199,632	$16,039,576

Exhibit 98: Project Grouping for All Strategies (including TDM & Modal) Continued

		Description	TDM	Modal	Operational	Capacity	Total Cost
	OP8	SC 290 Exit at I-85 SB (construct 2-lane exit and ramp)			$2,880,858		
		Lengthen deceleration lane			$960,286		
	OP7	SC 290 Exit at I-85 NB (construct 2-lane exit and ramp)			$2,880,858		
		Lengthen deceleration lane			$960,286		
	C10	Convert SC 290 Interchange to a DDI				$1,300,000	
	OP11	US 29 at I-85 (Lengthen NB deceleration lane and SB acceleration lane)			$1,920,572		
	OP12	SC 129 at I-85 (Lengthen NB deceleration lane and SB acceleration lane)			$1,920,572		
		Total			$11,523,432	$1,300,000	$12,823,432
		TOTAL - YEAR 2015	**$890,000**	**$11,300,000**	**$24,007,150**	**$28,921,208**	**$63,968,358**
		YEAR 2020					
	C11	Reconstruct I-385 Alternate 4				$240,000,000[1]	
		TOTAL - YEAR 2020					
		YEAR 2025					
	OP9	SC 14 Exit at I-85 SB (construct 2-lane exit and ramp)			$2,880,858		
		Lengthen deceleration lane			$960,286		
	C2	Add 4th SB lane from Laurens Road to CD exit ramp				$9,602,860	
		Bridge - Ridge Road				$3,398,850	
	C4	Add 4th SB lane Woodruff Road to Laurens Road (2020)				$10,563,146	
		2-lane exit ramp				$1,920,572	
		Bridge - Laurens Road				$3,586,800	
		Bridge - CSX RR				$2,940,000	
		Bridge - Salters Road				$3,704,750	
	C3	Convert Laurens Road interchange to Parclo A				$9,000,000	
	C8	Add 4th NB lane from Pelham Road entrance ramp to SC 14 exit				$9,602,860	
		Bridge - Batesville Road				$2,856,000	
		Bridge - Enoree River				$766,850.00	
	C14	Add 4th NB lane within Pelham Road interchange (2025)				$4,801,430	
	C1	Add 4th SB lane from Pleasantburg Drive to White Horse Road				$11,043,289	
		Bridge - Brushy Creek				$239,750	
		TOTAL - YEAR 2025			**$3,841,144**	**$74,027,157**	**$77,868,301**

Exhibit 98: Project Grouping for All Strategies (including TDM & Modal) Continued

		Description	TDM	Modal	Operational	Capacity	Total Cost
		YEAR 2030					
	C9	Add 4th SB lane from SC 14 entrance ramp to Pelham Road exit				$9,602,860	
		Enoree River				$766,850	
	C13	Add 4th SB lane within Pelham Road interchange (2025)				$4,801,430	
	C16A	Add 4th SB lane from Brockman-McClimon Road to SC 14				$10,083,003	
	OP10	SC 14 Acceleration Lane at I-85 SB (construct 2-lane acceleration lanes and ramps)			$4,801,430		
	C22	Add 5th NB lane from SC 129 to I-85 Bus				$5,281,573	
		TOTAL - YEAR 2030			**$4,801,430**	**$30,535,716**	**$35,337,146**
		YEAR 2035					
	C15	Add 4th NB lane from SC 14 entrance ramp to SC 129				$56,656,875	
	C18	Add 4th NB lane from SC 14 to SC 14/Aviation Drive entrance ramp				$6,241,859	
		TOTAL - YEAR 2035				**$62,898,734**	**$62,898,734**
		GRAND TOTAL ALL YEARS	**$929,000**	**$11,375,000**	**$33,124,724**	**$196,382,815[1]**	**$241,811,539[1]**

[1]Construction cost for I-385 Interchange is not included in the total as funding is established under a current project.

Exhibit 99: Project Grouping for Operational & Capacity Strategies

			Description	Road Length (miles)	Lanes (each)	Bridge Length	Bridge Width	Road Cost	Bridge Cost	Total Cost	Group Cost
			YEAR 2012								
	1	OP1	I-85/Woodruff Road CD Exit at I-85 SB (provide 2-lane exit)	LS				$50,000		$50,000	
	1	OP2	SC 101 Acceleration Lanes at I-85 NB and SB (lengthen acceleration lanes)	LS				$25,000		$25,000	
	1	OP32A	ITS - Active Traffic Management							$400,000	
			TOTAL - YEAR 2012					$75,000		$475,000	**$475,000**
			YEAR 2015								
Group	1A	OP5	Pelham road Exit at I-85 NB (construct 2-lane exit)	0.3	2			$2,880,858			
	1A		Lengthen deceleration lane	0.2	1			$960,286		$3,841,144	
	1A	C6	Add 4th NB lane from end 4th lane to Pelham Road exit	0.5	1			$2,400,715		$2,400,715	
	1B	C7	Add 4th SB 4th lane from Pelham Road to CD exit to I-385/Woodruff (2020)	2.7	1			$12,963,861		$12,963,861	
	1B	OP4	I-385/Woodruff CD Exit at I-85 SB (lengthen deceleration lane)	0.2	1			$960,286		$960,286	
	1C	C33	Temporary Shoulder Use					$57,000		$57,000	
			Total Group 1								$20,223,006
Group	2A	C2	Add 4th SB lane from Laurens Road to CD exit ramp	2	1			$9,602,860			
	2A		Ridge Road			312	62.25		$3,398,850	$13,001,710	
	2B	C4	Add 4th SB lane Woodruff Road to Laurens Road (2020)	2.2	1			$10,563,146		$10,563,146	
	2B		2-lane exit ramp	0.2	2			$1,920,572			
	2B		Laurens Road			244	84		$3,586,800		
	2B		CSX RR			200	84		$2,940,000		
	2B		Salters Road			290	73		$3,704,750	$12,152,122	
	2C	C3	Convert Laurens Road interchange to Parclo A	LS				$9,000,000		$9,000,000	
			Total Group 2								$44,716,978
Group	3A	C8	Add 4th NB lane from Pelham Road entrance ramp to SC 14 exit	2	1			$9,602,860			
	3A		Batesville Road			340	48		$2,856,000		
	3A		Enoree River			313	14		$766,850	$13,225,710	
	3A	C14	Add 4th NB lane within Pelham Road interchange (2025)	1	1			$4,801,430		$4,801,430	
	3B	C9	Add 4th SB lane from SC 14 entrance ramp to Pelham Road exit	2	1			$9,602,860			
	3B		Enoree River			313	14		$766,850.00	$10,369,710	
	3B	C13	Add 4th SB lane within Pelham Road interchange (2025)	1	1			$4,801,430		$4,801,430	
	3C	OP6	Pelham Road Exit at I-85 SB (construct 2-lane exit and ramp)	0.3	2			$2,880,858			
	3C		Lengthen deceleration lane	0.2	1			$960,286		$3,841,144	
			Total Group 3								$37,039,424
Group	4A	C1	Add 4th SB lane from Pleasantburg Drive to White Horse Road	2.3	1			$11,043,289			
	4A		Brushy Creek			137	10		$239,750.00	$11,283,039	
	4B	C12	Add 4th SB lane from CD exit near Mauldin Road to Pleasantburg Drive (2025)	0.5	1			$2,400,715		$2,400,715	
			Total Group 4								$13,683,754

Exhibit 99: Project Grouping for Operational & Capacity Strategies Continued

			Description	Road Length (miles)	Lanes (each)	Bridge Length	Bridge Width	Road Cost	Bridge Cost	Total Cost	Group Cost
Group	5A	C5	Add 4th NB lane from CD entrance to Laurens Road exit (2035)	2	1			$9,602,860			
	5A		2-lane CD entrance ramp and 2-lane exit ramp (2015)	0.2	2			$1,920,572			
			CD Bridge Reedy River			322	12		$676,200.00	$12,199,632	
	5B	OP3	I-385/Woodruff CD Exit at I-85 NB (construct 2-lane exit ramp)	0.3	2			$2,880,858			
	5B		Lengthen deceleration lane	0.2	1			$960,286		$3,841,144	
			Total Group 5								$16,040,776
Group	6A	OP8	SC 290 Exit at I-85 SB (construct 2-lane exit and ramp)	0.3	2			$2,880,858			
	6A		Lengthen deceleration lane	0.2	1			$960,286		$3,841,144	
	6B	OP7	SC 290 Exit at I-85 NB (construct 2-lane exit and ramp)	0.3	2			$2,880,858			
	6B		Lengthen deceleration lane	0.2	1			$960,286		$3,841,144	
	6C	C10	Convert SC 290 Interchange to a DDI	LS				$2,000,000		$2,000,000	
	6D	OP11	US 29 at I-85 (Lengthen NB deceleration lane and SB acceleration lane)	0.4	1			$1,920,572		$1,920,572	
	6E	OP12	SC 129 at I-85 (Lengthen NB deceleration lane and SB acceleration lane)	0.4	1			$1,920,572		$1,920,572	
			Total Group 6								$13,523,432
			TOTAL - YEAR 2015					**$126,291,321**	**$18,936,050**	**$145,170,371**	**$145,227,371**
			YEAR 2020								
		C11	Reconstruct I-385 Interchange	LS							$240,000,000
			TOTAL - YEAR 2020								**$240,000,000**
			YEAR 2025								
Group	1A	C16	Add 4th SB lane from SC 101 entrance ramp to SC 14	4.1	1			$19,685,863		$19,685,863	
	1B	OP9	SC 14 Exit at I-85 SB (construct 2-lane exit and ramp)	0.3	2			$2,880,858			
	1B		Lengthen deceleration lane	0.2	1			$960,286		$3,841,144	
	1C	OP10	SC 14 Acceleration Lane at I-85 SB (construct 2-lane acceleration lanes and ramps)	0.5	2			$4,801,430		$4,801,430	
	1D	C17	Construct SB-2 lane exit ramp at SC 14/Aviation Drive	0.8	2			$7,682,288			
	1D		Lengthen deceleration lane	0.2	1			$960,286		$8,642,574	
			Total Group 1								$36,971,011

Exhibit 99: Project Grouping for Operational & Capacity Strategies Continued

			Description	Road Length (miles)	Lanes (each)	Bridge Length	Bridge Width	Road Cost	Bridge Cost	Total Cost	Group Cost
Group	2	C15	Add 4th NB lane from SC 14 entrance ramp to SC 129	11.8	1			$56,656,875			
	2		New Jetport entrance flyover			560	37.25		$3,650,500		
	2		Duncan-Reidville Road			270	62.25		$2,941,313		
	2		Danzler Road			300	62.25		$3,268,125		
	2		South Tyger River			318	16.3		$907,095		
	2		Middle Tyger River			246	16.3		$701,715		
	2		Nazareth Road			294	62.25		$3,202,763		
	2		US 29 & CSX RR			543	16.2		$1,539,405		
	2		Southern RR			138	28		$676,200		
	2		North Tyger River			246	16.3		$701,715	$74,245,705	
	2	C22	Add 5th NB lane from SC 129 to I-85 Bus	1.1	1			$5,281,573		$5,281,573	
			Total Group 2								$79,527,278
			TOTAL - YEAR 2025					**$98,909,459**	**$17,588,830**	**$116,498,289**	**$116,498,289**
			YEAR 2030								
Group	1A	C18	Add 4th NB lane from SC 14 to SC 14/Aviation Drive entrance ramp	1.3	1			$6,300.00		$6,300.00	
	1B	C28	Add 5th SB lane from SC 14 entrance ramp to I-385 exit	3.1	1			$14,884,433			
			Pelham Road			354	106		$6,566,700		
	1B		Enoree River			313	12		$657,300	$22,108,433	
	1C	C29	Add 5th NB lane Pelham Road exit ramp to SC 14 exit ramp	2.9	1			$13,924,147			
	1C		Enoree River			313	12		$657,300	$14,581,447	
			Total Group 1								$42,931,739
Group	2	C19	Add 4th SB lane from I-85 Bus to SC 101	9	1			$43,212,871			
	2		South Tyger River			318	12		$667,800		
	2		Middle Tyger River			246	12		$516,600		
	2		US 29 & CSX RR			543	22		$2,090,550		
	2		Southern RR		1	138	28		$676,200		
	2		North Tyger River			246	12		$516,600	$47,680,621	
			Total Group 2								$47,680,621
			TOTAL - YEAR 2030					**$78,263,310**	**$12,349,050**	**$90,612,359**	**$90,612,359**
			YEAR 2035								
Group	1	C23	Add 4th NB lane from I-85 Bus to I-26 exit	1.2	1			$5,761,716			
	1		I-85 Bus			380	22		$1,463,000		
	1		Road S-41			144	22		$554,400	$7,779,116	
			Total Group 1								$7,779,116

Exhibit 99: Project Grouping for Operational & Capacity Strategies Continued

			Description	Road Length (miles)	Lanes (each)	Bridge Length	Bridge Width	Road Cost	Bridge Cost	Total Cost	Group Cost
Group	2	C20	Add 4th NB lane from Laurens Road exit to Woodruff Road/I-385 CD	2	1			$9,602,860			
	2		Laurens Road			244	84		$3,586,800		
	2		CSX RR			100	84		$1,470,000	$14,659,660	
			Total Group 2								$14,659,660
Group	3	C21	Construct NB 2-lane exit ramp at Brockman-McClimon Road	1	1	244	40	$4,801,430	$1,708,000	$6,509,430	
			Total Group 3								$6,509,430
Group	4A	C24	Add 5th SB lane from Augusta Road entrance to White Horse Road exit ramp	1.3	1			$6,241,859		$6,241,859	
	4B	C25	Add 5 NB lane from CD entrance ramp to Laurens Road exit ramp	2	1			$9,602,860			
			Brushy Creek			137	12		$287,700	$9,890,560	
	4C	C26	Add 5th SB lane from Laurens entrance ramp to CD exit ramp	2	1			$9,602,860		$9,602,860	
	4D	C27	Add 5th SB lane from Woodruff Road exit to Laurens Road entrance ramp	2.2	1			$10,563,146			
	4D		CSX RR			100	12		$210,000	$10,773,146	
			Total Contract 4								$36,508,425
Group	5	C30	Add 5th NB lane from SC 101 entrance ramp to SC 290 exit ramp	2.2	1			$10,563,146			
			South Tyger River			318	12		$667,800	$11,230,946	
			Total Group 5								$11,230,946
			TOTAL - YEAR 2035					**$66,739,878**	**$9,947,700**	**$76,687,578**	**$76,687,578**
			GRAND TOTAL ALL YEARS					**$370,278,968**	**$58,821,630.00**	**$429,500,598**	**$429,500,598^**

[1]Items C4, C7, C12, C13, C14 were moved to 2015 contracts.
[2]The dates given for the contract groupings do not consider the benefits of implementing TDM and modal strategies. Adjusted dates for implementation of the various capacity strategies are shown in the Capacity Improvement Summary table in Chapter 10.
^Construction cost of I-385 interchange is not included in the total as funding is established under a current project.

Chapter 3: Development of Corridor Model

The study was conducted using the VISSIM traffic modeling software. VISSIM is a microscopic simulation software package which analyzes multi-modal traffic flows with the flexibility of modeling all types of geometries and traffic control schemes. The research which supports the algorithms used in VISSIM have been tried and tested for over 20 years and the software itself has been in use since the early 1990s.

In modeling traffic operations with any traffic micro-simulation model, the travel demand patterns are important factors. Traffic can operate at a high level of service if there are not too many short trips in the travel demand. These short trips enter the freeway, stay in the right lane, and exit the freeway at the downstream interchange. Longer trips tend to change lanes or weave, creating turbulence on the freeway. For this reason, the first step in the model development was to estimate the travel demand in an origin-destination (OD) matrix format. Travel demand patterns projected by the GPATS regional model as well as observed traffic count data were used in order to create the OD matrix. Furthermore, the observed traffic count data represents the number of vehicles that were "processed". If severe congestion was present, the observed traffic count would be lower than the actual demand, but the observed speed would be slow. The use of an OD matrix allows for the adjustment of trips to account for the latent demand that is missing from the observed traffic counts.

The estimated OD was assigned to the highway network using the dynamic traffic assignment (DTA) feature in VISSIM. Because the calibrated VISSIM model would be passed on to another consultant for alternative analysis, the calibrated DTA VISSIM model was converted to a static route model. It is to be noted that the simulated results from running DTA were slightly different when compared to those from the model containing static routes. The static route model was adjusted to ensure that the simulation results of the final VISSIM static route model matched well against the observed existing traffic conditions.

3.1 DATA COLLECTION

Several elements were required in order to develop the base network for the VISSIM model. The necessary data included lane geometry, traffic control data, demand data, and calibration data. Each of these elements is described in detail below.

Geometric Data

Geometric data such as link distance, number of lanes, turning lane storage length, lane width, and curvature were obtained from aerial photography. The aerial photography was provided by Greenville and Spartanburg Counties.

Traffic Control Data

Intersection signal timing and phasing plans were obtained from SCDOT. For each of the arterials, the signal timing plans were optimized in Synchro based on the turning movement counts and the phasing plans. Generally, traffic signals along the same arterial were assumed to be coordinated due to the short distances between signalized intersections. The signal timing optimization was deemed necessary because signal timing and phasing plans were designed using traffic data in the past. The optimization updated the timings based on more recent traffic data.

Demand Data

TRAFFIC COUNT DATA

Turning movement counts were collected from 6:30 AM to 8:30 AM and from 4:30 PM to 6:30 PM on a Tuesday, Wednesday, or Thursday. The counts were done in 15 minute increments and were classified by vehicle type. Detailed traffic count data can be found in the VISSIM Model and Calibration Report (STANTEC, November 2010). The counts were performed during the months of April 2010 and May 2010 for 35 intersections associated with 10 crossing route interchanges.

Tube counts were collected for 24-hour periods in 15 minute increments on a Tuesday, Wednesday, or Thursday during the months of April 2010 and May 2010 from Augusta Road to SC 101.

Additionally, turning movement counts and 24-hour tube counts were collected during the months of April 2009 and May 2009 at the Woodruff Road, I-385, and Pelham Road interchanges with I-85. These counts were included in the report, I-85/I-385 Interchange Improvements Study (Florence & Hutcheson, November 2009). Turning movement counts were collected during the AM and PM peak hours, from 7:00 AM to 9:00 AM and 4:00 PM to 6:00 PM, respectively. Because the counts were performed within one year of this study and per approval by the client, volumes from these traffic counts were used in this study.

Historical AADT data for 14 count stations on I-85 were provided by SCDOT. The estimated 2009 volumes were projected based on historical AADT data from the past 10 years. Hourly traffic count data was obtained from Automatic Traffic Recorders (ATR) collecting data at Count Stations 2291 (I-85 between White Horse Road and Augusta Road) and 2313 (I-85 between US 29 and SC 129 (Fort Prince Boulevard)). Using this data, the AM and PM peak hours along the mainline were determined to be 7:00 AM – 8:00 AM and 5:00 PM – 6:00 PM, respectively.

An approximate, yet realistic directional split of 60%/40% south of I-385 and 50%/50% north of I-385 was calculated using the ATR data. Also using this data, a K-factor (peak-to-daily ratio) of 0.09 was determined. These factors were multiplied by the projected 2010 AADT along each segment in order to estimate the peak hour traffic at each station. Those volumes were used as a baseline for the mainline traffic volumes and were adjusted based on the traffic counts at each interchange.

For the turning movement counts, the four consecutive 15-minute intervals containing the highest one-hour total were used as the peak hour for each intersection. Volumes along each side street were then balanced, if necessary, in order to provide an accurate and reasonable model of the traffic along each roadway. The peak hour truck percentage used for the purposes of this study was determined to be 12%. The estimated truck percentage on the Interstate freeway facility was compared to the observed truck percentage. The comparisons indicate that the estimated truck percentages on the Interstate facility are close to the observed percentages.

VEHICLE CLASSIFICATION DATA

Vehicle classification count data on I-385 and I-85 on either side of the I-385 and I-85 interchange were made available from the I-85/I-385 Interchange Improvements Study (Florence & Hutcheson, November 2009) report. The percentages of trucks were calculated using this data.

ORIGIN–DESTINATION DATA

The daily origin-destination (OD) travel patterns for the segment between Augusta Road and SC 101 were extracted from the regional travel demand model that was developed for GPATS for the MPO responsible for the urbanized Greenville area.

The AM and PM peak hour OD trip tables for cars and trucks were estimated using the observed traffic count data and the OD travel pattern extracted from the GPATS model. The OD estimation was performed using the TFlow Fuzzy module in VISSIM.

Comparison of the observed and estimated traffic volumes during the AM and PM peak hours indicated a close correlation.

Exhibit 8: Total Network Volume Summary

Time Period	Number of Cars (vph)	Number of Trucks (vph)
AM Peak Hour	37,351	4,608
PM Peak Hour	38,844	4,914

CALIBRATION DATA

The field inspections conducted May 2010 and September 2010 were used during the calibration process to ensure the existing models matched current field conditions. Notes of the observed traffic operations on the freeway and arterials were logged. Observed queue lengths at selected locations were also recorded. This set of observed data was used as the primary calibration data.

The observed traffic count data, as discussed above, was used as the secondary data in the calibration process. The demand OD trip table was also adjusted in the calibration process, in order to achieve realistic traffic conditions.

Speed data was provided by INRIX through SCDOT. It is noteworthy to mention that the average travel times and speeds that INRIX provided were inconsistent with the observed traffic operations during the field visits. As a result, the average travel time was used cautiously during the calibration process.

3.2 BASE MODEL DEVELOPMENT

A static base model was developed using the VISSIM traffic modeling software. The initial routing decisions were estimated based on traffic count data. The routing decisions were updated during the calibration process. This section briefly describes the various components of the base model and underlying assumptions.

Highway Network

Aerial photography was used as the overlay in the background for creating the VISSIM highway network. The use of the aerial photography allowed for the ability to capture precise lane geometry, intersection geometry, and interchange configurations. Links with wide pavement width, but striped as only one-lane facilities were identified and coded as conflict areas. Link type and driver behavior type were assigned to the network links accordingly. The desired speed distribution was also assigned to the link based upon observed speed limits and traffic operations.

Intersection traffic control devices were added to the highway network. The phasing plans provided by SCDOT and the optimized timing plans were coded for all signalized intersections. Stop signs were added to all unsignalized intersections. Priority rules and/or conflict areas were also added to control any movements which may required yielding.

Vehicle Inputs

The traffic count data was balanced for the AM and PM peak hours. The estimated peak hour car and truck traffic volumes were entered to the network as vehicle inputs. These vehicle inputs were added on the links where the vehicles entered the network.

Vehicle Composition

Five vehicle types, which were broken down into categories of "car" and "truck", were assumed in the base model. Truck traffic on I-85 was determined to be approximately 12% on average during the peak hour.

Driver Behavior

The driver behavior included the desired speed distributions and the driver aggressiveness. The VISSIM default speed distribution curves were assumed as the starting point. Based upon observed speed limits, the distribution curves were adjusted based on the observed speed limits and the field observations. The distribution curves were further adjusted during the calibration process. The VISSIM default parameters for urban and freeway driver behavior were assumed as the starting point and adjusted during calibration.

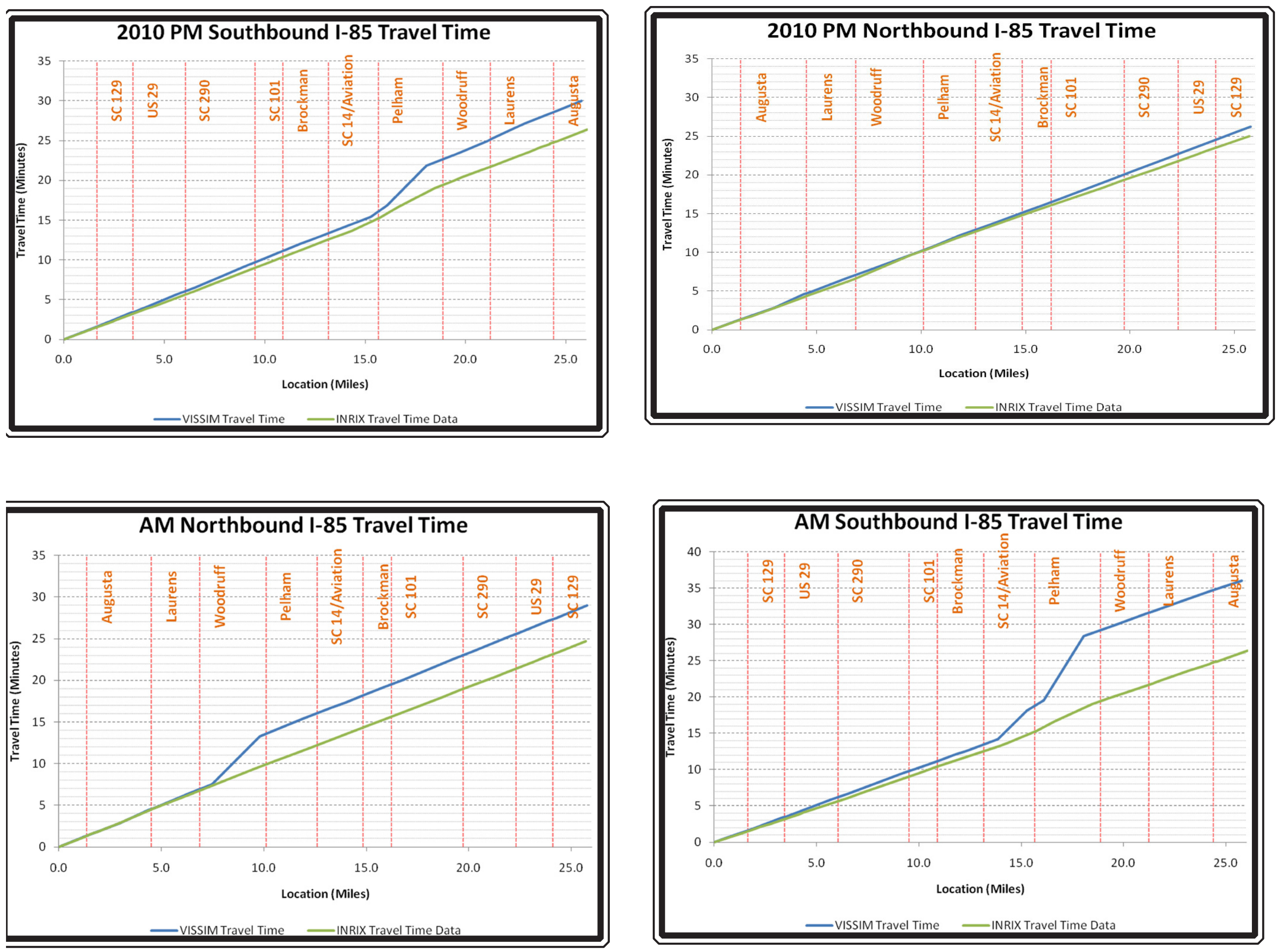
3.3 CALIBRATION

The calibration approach involved two phases of calibration. In Phase 1, the primary objective was to calibrate the model so that it would match the observed traffic volumes and traffic conditions as closely as possible. The desired speed distribution curves, the parameters of driver behavior, and signal timing were adjusted. However, due to some questionable count data, the model could not replicate the observed traffic conditions on I-85 southbound, north of the I-385/Woodruff Road CD ramp. As a result, the demand OD trip table was adjusted in Phase 2. Calibration for the AM peak hour traffic conditions was completed at the end of Phase 1. However, Phase 2 was required for the PM peak hour model calibration.

3.4 VALIDATION

As discussed above, the observed traffic operating conditions were used as the primary validation data. The traffic count data was also used for validation, but with reservation due to some questionable data. Overall, the estimated queue lengths were confirmed by the observed data for both peak hours. The estimated travel time on I-85 between interchanges were compared with the observed (INRIX) travel times during both the AM and PM peak hours. Overall, the AM and PM peak hour VISSIM models were able to replicate the travel time when traffic was operating at or close to free-flow conditions. The simulation results were consistent with the observed traffic conditions. Exhibit 9 shows these comparisons.

Exhibit 9: Travel Time Validation



3.5 EXISTING AND FUTURE TRAVEL DEMAND

The following sections include the output for all of the performance measures listed in the previous section. They are broken out into three sections including network performance, freeway analysis, and intersection analysis.

EXISTING CONDITIONS

The following sections show the VISSIM simulation results for the existing (2010) AM and PM peak hours. These results show the traffic conditions on both the I-85 mainline as well as the side street intersections. These were calculated by the VISSIM modeling software. Any further calculations were made using conventional Highway Capacity Manual (HCM) methodology.

Network Performance

AM PEAK HOUR

Exhibit 10 shows a summary of the average delay time per vehicle and the average speed on a network-wide basis for the AM peak hour. These are to be used primarily for comparison purposes between alternatives.

Exhibit 10: Existing (2010) AM Peak Hour Network Performance Summary

Parameter	Value
Average delay time per vehicle (seconds)	165
Average speed (mph)	37.7

PM PEAK HOUR

Exhibit 9 shows a summary of the average delay time per vehicle and the average speed on a network-wide basis for the PM peak hour. These are to be used primarily for comparison purposes between alternatives.

Exhibit 11: Existing (2010) PM Peak Hour Network Performance Summary

Parameter	Value
Average delay time per vehicle (seconds)	119
Average speed (mph)	42.7

Traffic Growth Rates

In order to calculate the future year traffic volumes, growth rates along I-85 and the side streets in the study area were determined using 10-year historical AADT data. This data was obtained from SCDOT. In order to provide an accurate and reasonable model for the I-85 corridor, three growth rates were used based on historical AADT data. Individual growth rates were calculated for each side street in the study area. Because the interchange at Brockman-McClimon Road was recently constructed and a growth rate was unreliable to estimate for an extended period of time, estimated AADTs were used in lieu of an annual growth rate when determining the future year volumes for this interchange.

The individual growth rates as generated by GPATS, SPATS, historical growth, as well as the recommended growth rates from the I-85/I-385 Interchange Improvements Study (Florence & Hutcheson, November 2009) as shown in Exhibits 13 and 14.

VISSIM is a powerful tool for analyzing traffic on a corridor such as I-85. It will also be useful in the analysis of further alternatives, especially those involving multi-modal forms of travel, because of its capabilities in that area. It is a valuable tool for incorporating transit into a vehicular network. It also has the ability to measure the effectiveness a multitude of elements.

The detail used in coding this model is what makes it so powerful. The data used to input these details has been well-documented throughout the modeling process and is believed to be as accurate as possible. The data, which was collected from field visits, traffic counts, and other sources, was an integral part of the modeling process. Existing signal timing plans, traffic counts, speed data, lane geometry, and traffic control devices were all obtained during the data collection process.

In calibrating this model, several guidelines were followed to insure that the model adequately matched existing conditions. Several elements were used in the study to optimize the accuracy, reliability, and effectiveness of the model. Those elements include OD data, speed data, travel times, observed congestion and delay, as well as observed queuing. The document Traffic Analysis Toolbox Volume III: Guidelines for Applying Traffic Microsimulation Modeling Software (USDOT/FHWA, July 2004) was the primary source of the calibration guidelines used in this study. By following these guidelines and adhering to best practices for microsimulation modeling, this model is believed to provide an accurate representation of the existing traffic conditions as well as projected conditions during the design years of 2015 and 2035.

Existing and Future Traffic Volumes

The AADT volumes were projected based on a growth rate 1.8% per year. These projected volumes are shown in Exhibit 15 in five-year increments. In 2010 the traffic volumes range from a low of 77,200 vpd between US 29 and SC 129 to a high of 107,000 vpd between I-385 and Pelham Road. The corridor generally can be divided into five segments based on 2010 AADT. These segments are shown in Exhibit 12 with approximate projected traffic volumes for both 2010 and 2035.

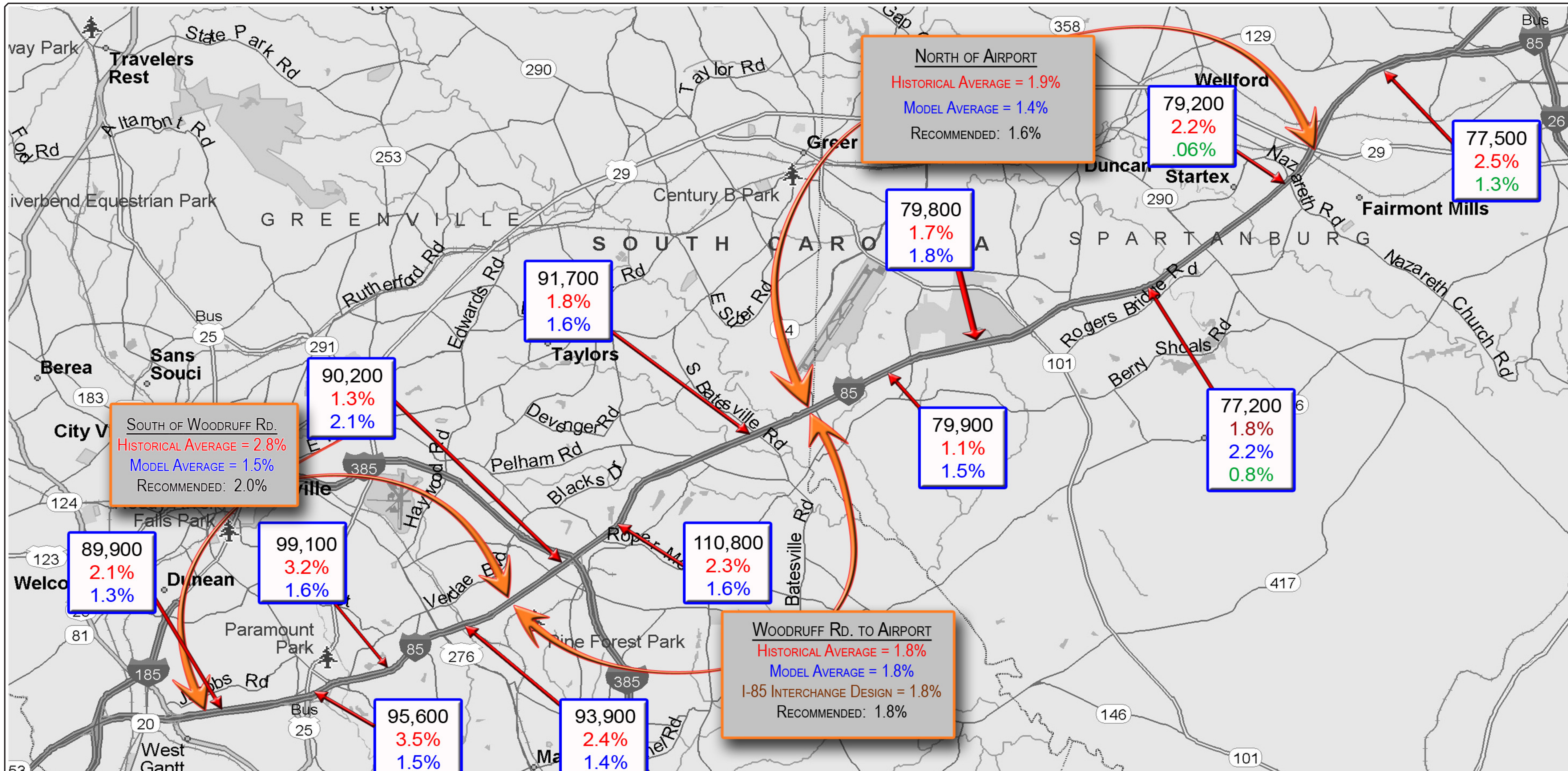
Exhibit 12: Projected Traffic Volumes by Segment

SEGMENT	LENGTH (MILES)	2010 AADT (VPD)	2035 AADT (VPD)
White Horse Road to Laurens Road	4.9	95,000	145,000
Laurens Road to I-385	2.6	90,000	140,000
I-385 to Pelham Road	2.9	107.000	175,000
Pelham Road to SC 14	2.2	90,000	155,000
SC 14 to Fort Prince Boulevard (SC 129)	12.0	80,000	130,000

The lowest volume and longest segment is SC 14 north to Fort Prince Boulevard with an average 2010 AADT of 80,000 vpd and 2035 AADT of 130,000 vpd. The highest volume segment is from I-385 to Pelham Road with a 2010 AADT of 107,000 vpd and a 2035 AADT of 175,000 vpd.

The effects of these increased traffic volumes on I-85 can be seen in Exhibit 16, which shows the levels of service in the morning and afternoon for traffic in both directions. When comparing the level of service for 2010 and 2035, dramatic increases in the lengths of the segments showing and level of service (LOS) F can be easily seen. Based on traffic growth, current driving habits, and current use of various transportation modes it becomes clear that the travel demand will easily exceed the capacity of I-85 for much of the length of the study corridor.

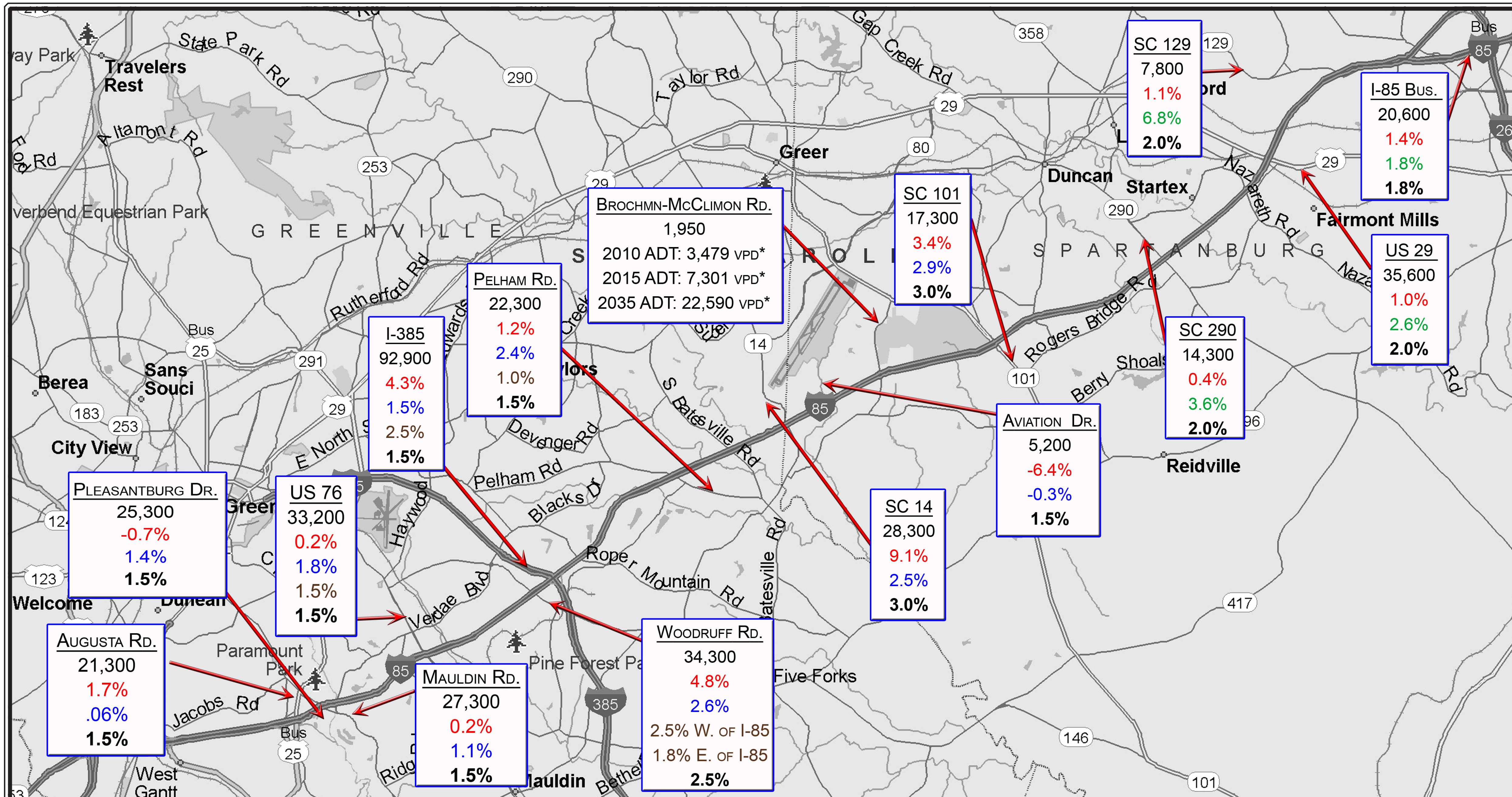
Exhibit 13: Projected Annual Growth Rates for I-85 Corridor (Augusta Road to SC 129)



Legend

65,300	2008 Annual Average Daily Traffic Volume from SCDOT
3.5%	Projected annual growth rate using linear regression analysis of the available historical counts over the past 10 years (1998-2008)
2.2%	Projected annual growth rate from Greenville Pickens Area Transportation Study (GPATS) Model
1.1%	Projected annual growth rate from Spartanburg Area Transportation Study (SPATS) Model
1.5%	Annual Growth rate recommended in the Florence & Hutchinson I-85/I-385 Interchange Improvements study
1.8%	Recommended annual growth rate for use in the I-85 Corridor Analysis

Exhibit 14: Projected Annual Growth Rates for Side Streets Along I-85 (Augusta Road to SC 129)



Legend

- 15,300 — 2008 Annual Average Daily Traffic Volume from SCDOT (If the roadway has cross-street segments both West and East of I-85, value shown is the higher of the two segments)
- 3.5% — Projected annual growth rate using linear regression analysis of the available historical counts over the past 10 years (1998-2008)**
- 2.2% — Projected annual growth rate from Greenville Pickens Area Transportation Study (GPATS) Model**
- 1.1% — Projected annual growth rate from Spartanburg Area Transportation Study (SPATS) Model**
- 1.5% — Annual Growth rate recommended in the Florence & Hutchinson I-85/I-385 Interchange Improvements study
- **1.8% — Recommended annual growth rate for use in the I-85 Corridor Analysis**

*Projected ADTs were used in lieu of growth rates

**If the roadway has cross-street segments both West and East of I-85, value shown is the weighted average of the two segments.

Exhibit 15: Projected AADTs (Augusta Road/US 25 to SC 129)

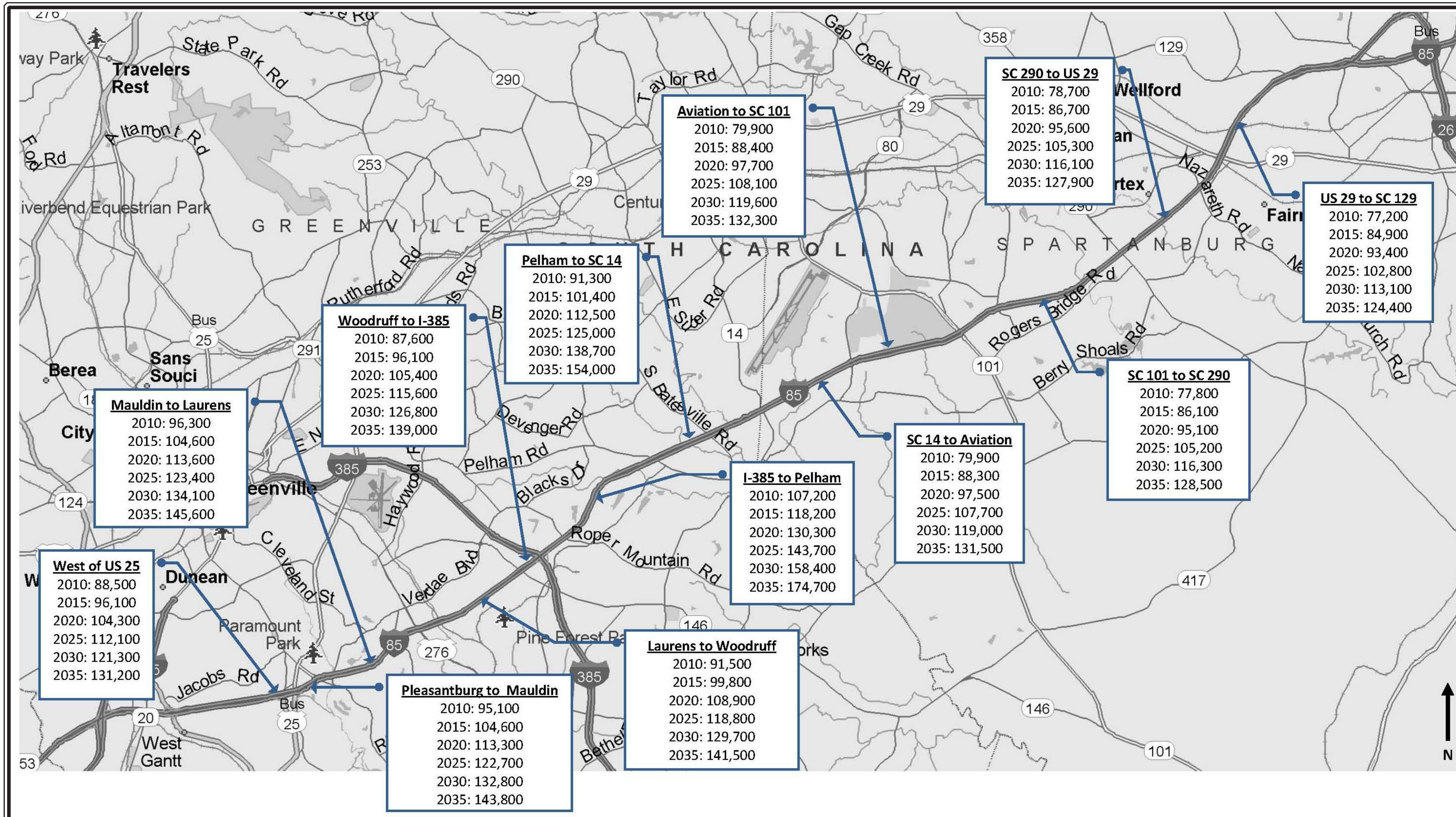
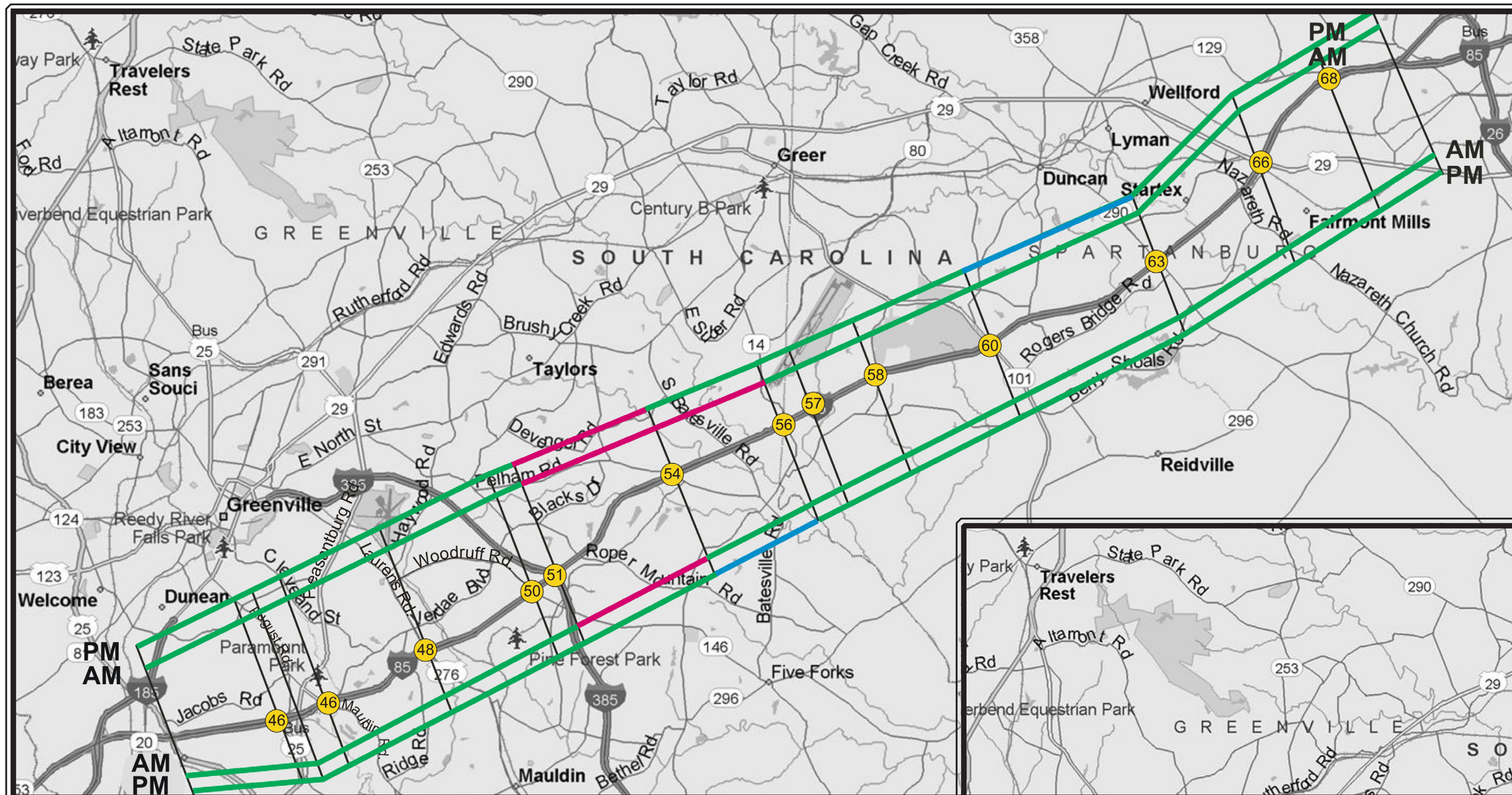
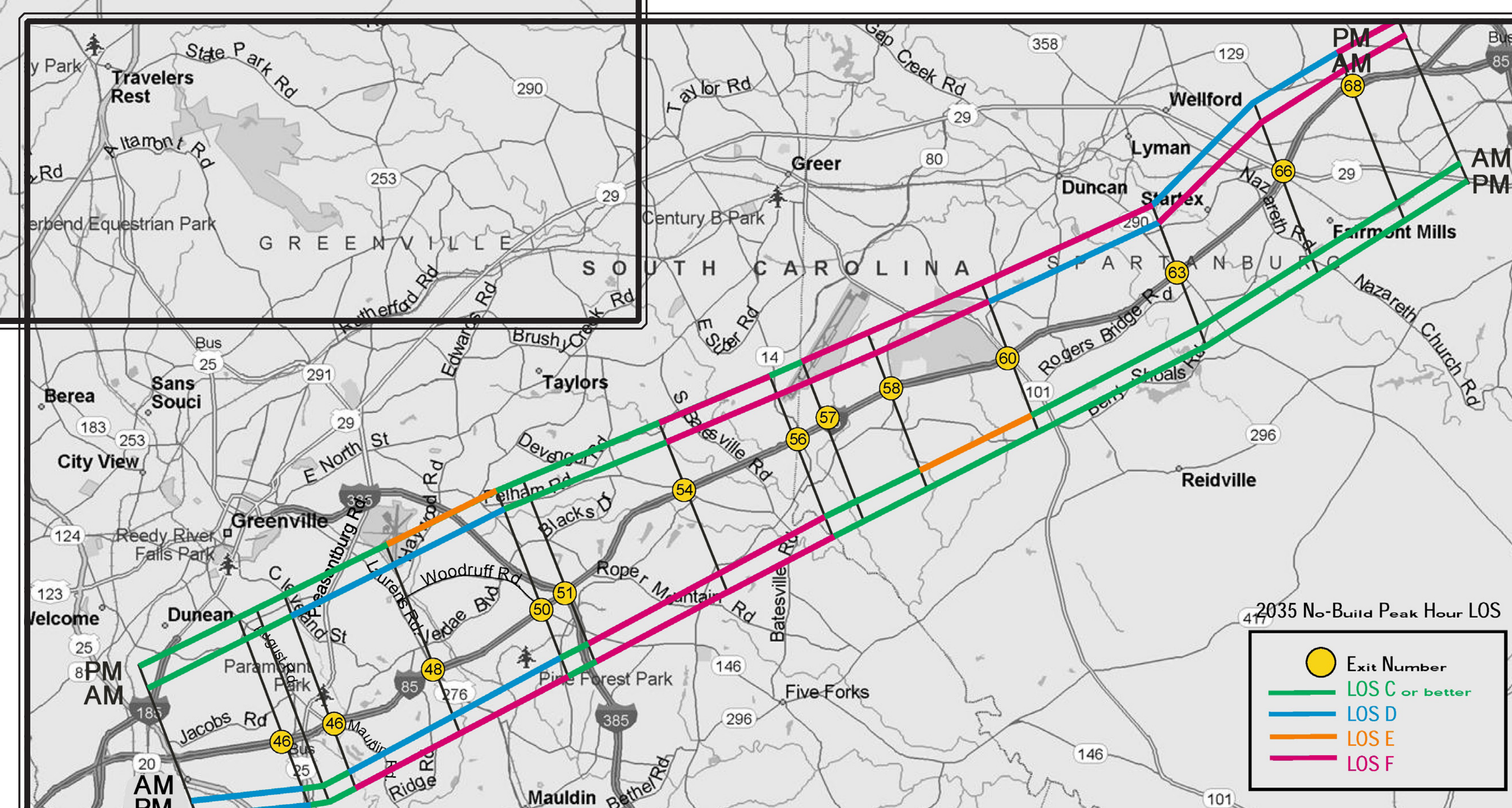


Exhibit 16: Level of Service (LOS) 2010 and 2035, AM/PM

LOS 2010



LOS 2035



3.6 USE OF MODEL FOR EVALUATION OF IMPROVEMENTS

The VISSIM base model with the application of 2035 traffic projections (2035 No Build) serves as the basis for comparison of major improvements that may be implemented in the future. These comparisons are used in this report to provide an evaluation of the major improvements along the I-85 corridor. A number of scenarios were modeled by adding proposed improvements to the 2035 No Build model. Exhibit 15 lists the various evaluation models that were used in this study along with a brief description. These evaluation models include many of the strategies that are discussed in more detail in later in this report. The general results of the evaluation models are shown in Exhibit 17.

Exhibit 17: Evaluation Models for 2035

Model Name	Description
2035 No Build	Includes existing freeway configuration with no improvements
2035 3-Lane	Includes existing freeway with ramp improvements
2035 4 Lane Build	Includes ramp improvements, interchange improvements, four basic lanes in each direction, and reconstruction of the I-385 interchange
2035 HOV	Includes ramp improvements, interchange improvements, three basic lanes in each direction, one HOV lane in each direction, and reconstruction of the I-385 interchange
2035 HOT	Includes ramp improvements, interchange improvements, three basic lanes in each direction, one HOT lane in each direction, and reconstruction of the I-385 interchange
2035 Modal	Reduces projected 2035 traffic volumes by 4.7% for trucks and 14.7% for cars to simulated implementation of traffic demand management and modal options; applies reduced traffic to existing freeway configuration with no improvements

Chapter 4: Effectiveness of Existing I-85

Motorist who live and work in the Greenville-Spartanburg area and regularly use I-85 between White Horse Road and SC 129 intuitively know the traffic conditions along the interstate. Collectively, these motorists know where traffic slows down, where and when congestion is likely to occur, and which interchange ramps will backup. Can the conditions be measured and quantified in a way that identifies the traffic conditions in the peak travel hours? The use of field observations and calibration of the VISSIM traffic simulation model as described in Chapter 3 make it possible to tabulate the conditions for comparison purposes. This chapter provides a wide spectrum of data based on the traffic conditions in 2010, making it possible to benchmark the effectiveness of I-85 today. Without changes in travel demand, shifts in modes of travel, operational improvements, or adding highway capacity; traffic conditions will grow worse as traffic increases in the future. These projected increases in traffic are modeled for the design year 2035. The data in this chapter establishes the baseline from which future conditions are projected.

4.1 FIELD OBSERVATIONS

Field visits were made during May 2010 and September 2010 to observe existing conditions. During these visits, traffic conditions during both the AM and PM peak hours were noted. Vehicular trips up and down the corridor during both peak hours were made and speed, delay, and queuing observations were noted. A visit to the Traffic Management Center (TMC) in Greenville, SC was also made in order to discuss traffic conditions with local SCDOT personnel and observe existing traffic conditions further. A summary of observations regarding traffic conditions on I-85 during these field visits are shown in Exhibits 18 and 19.

Exhibit 18: AM Peak Hour Observed Traffic Conditions

I-85 Segment	Northbound Description	Southbound Description
South end of study to Augusta Rd.	Light to moderate traffic	Light to moderate traffic
Augusta Rd. to S. Pleasantburg Dr.	Light to moderate traffic	Light to moderate traffic
S. Pleasantburg Dr. to Mauldin Rd.	Light to moderate traffic	Light to moderate traffic
Mauldin Rd. to US 276 (Laurens Rd.)	Light to moderate traffic	Light to moderate traffic
US 276 (Laurens Rd.) to SC 146 (Woodruff Rd.)	Moderate Traffic	Light to moderate traffic
SC 146 (Woodruff Rd.) to I-385	Moderate Traffic	Moderate Traffic
I-385 to Pelham Rd.	Congestion extended approximately ¾ mile in advance of Pelham Rd. off-ramp; speeds estimated at 45 mph	Congestion (at its peak) extended approximately 2.5 miles in advance of the I-385/Woodruff Rd. C-D off-ramp; speeds estimated at 20 mph
Pelham Rd. to SC 14	Moderate Traffic	Congestion extended approximately ¼ mile in advance of Pelham Rd. off-ramp; speeds estimated at 45 mph
SC 14 to Aviation Dr.	Light to moderate traffic	Moderate Traffic
Aviation Dr. to Brockman-McClimon Rd.	Light to moderate traffic	Light to moderate traffic
Brockman-McClimon Rd. to SC 101	Light to moderate traffic	Light to moderate traffic
SC 101 to SC 290 (E. Main St.)	Light to moderate traffic	Light to moderate traffic
SC 290 (E. Main St.) to US 29	Light to moderate traffic	Light to moderate traffic
US 29 to SC 129 (Fort Prince Blvd.)	Light to moderate traffic	Light to moderate traffic
SC 129 (Fort Prince Blvd.) to I-85 Business	Light to moderate traffic	Light to moderate traffic

Exhibit 19: PM Peak Hour Observed Traffic Conditions

I-85 Segment	Northbound Description	Southbound Description
South end of study to Augusta Rd.	Light to moderate traffic	Light to moderate traffic
Augusta Rd. to S. Pleasantburg Dr.	Light to moderate traffic	Light to moderate traffic
S. Pleasantburg Dr. to Mauldin Rd.	Light to moderate traffic	Light to moderate traffic
Mauldin Rd. to US 276 (Laurens Rd.)	Light to moderate traffic	Light to moderate traffic
US 276 (Laurens Rd.) to SC 146 (Woodruff Rd.)	Light to moderate traffic	Light to moderate traffic
SC 146 (Woodruff Rd.) to I-385	Light to moderate traffic	Light to moderate traffic
I-385 to Pelham Rd.	Congestion (at its peak) extended approximately 1000 feet beyond the Pelham Rd. off-ramp; speeds estimated at 55 mph	Congestion extended approximately 2.5 miles in advance of the I-385/Woodruff Rd. C-D off-ramp; speeds estimated at 20 mph
Pelham Rd. to SC 14	Light to moderate traffic	Congestion extended approximately 1 mile in advance of the Pelham Rd. off-ramp to mile marker 55; speeds estimated at 35 mph
SC 14 to Aviation Dr.	Light to moderate traffic	Moderate traffic
Aviation Dr. to Brockman-McClimon Rd.	Light to moderate traffic	Light to moderate traffic
Brockman-McClimon Rd. to SC 101	Light to moderate traffic	Light to moderate traffic
SC 101 to SC 290 (E. Main St.)	Moderate traffic	Light to moderate traffic
SC 290 (E. Main St.) to US 29	Light to moderate traffic	Light to moderate traffic
US 29 to SC 129 (Fort Prince Blvd.)	Light to moderate traffic	Light to moderate traffic
SC 129 (Fort Prince Blvd.) to I-85 Business	Light to moderate traffic	Light to moderate traffic

Vehicle Classification Data

Vehicle classification count data on I-385 and I-85 on either side of the I-385 and I-85 interchange were made available from the I-85/I-385 Interchange Improvements Study (Florence & Hutcheson, November 2009) report. The percentages of trucks were calculated using this data. The vehicles identified as trucks in this study included the following FHWA vehicle classes:

Class 5 – Two-axle, six-tire, single-unit trucks
Class 6 - Three-axle single-unit trucks
Class 7 – Four or more axle single-unit trucks
Class 8 – Four or fewer single-trailer trucks
Class 9 – Five-axle single-trailer trucks
Class 10 – Six or more axle single-trailer trucks
Class 11 – Five or fewer axle multi-trailer trucks
Class 12 – Six-axle multi-trailer trucks
Class 13 – Seven or more axle multi-trailer trucks

The observed vehicle classification count data are summarized in Exhibit 20.

Exhibit 20: I-85 Vehicle Classification Data

Class	I-85 between Woodruff Rd. & I-385		I-85 between I-385 and Pelham	
	Northbound	Southbound	Northbound	Southbound
1-4*	88.5	87.6	83.9	85.2
5-7	4.2	4.1	3.0	2.6
8-13	7.3	8.3	13.1	12.2

Class 1 – Motorcycle
Class 2 – Passenger Car
Class 3 – Two-axle, four-tire single-unit vehicles
Class 4 - Bus

4.2 MEASURES OF EFFECTIVENESS

Several key measures of effectiveness (MOE's) were evaluated for the existing I-85 based on current traffic conditions. These MOE's include average travel time, delay, average travel speed, level of service (LOS), density, queue length, emissions, fuel consumption, and total network delay. The VISSIM simulation model was run for the existing (2010) AM and PM peak hours. The output data for the performance measures provided in the remainder of this chapter are broken into three sections including network performance, freeway analysis, and intersection analysis. These results show the traffic conditions on both the I-85 mainline as well as the side street intersections.

NETWORK PERFORMANCE

AM PEAK HOUR

Exhibit 21 shows a summary of the average delay time per vehicle and the average speed on a network-wide basis for the AM peak hour.

Exhibit 21: Existing (2010) AM Peak Hour Network Performance Summary

Existing (2010) AM Peak Hour Network Performance Summary	
Parameter	Value
Average delay time per vehicle (seconds)	164.7982
Average speed (mph)	37.7252

Exhibit 22 shows a summary of emissions and fuel consumption for the study area during the AM peak hour. The data is broken down by interchange. In general, each interchange area extends approximately half the distance to the upstream and downstream interchanges.

Exhibit 22: Existing (2010) AM Peak Hour Emissions and Fuel Consumption Summary

Existing (2010) AM Peak Hour EMISSIONS AND FUEL CONSUMPTION SUMMARY					
Node ID	Interchange	CO Emissions (g/hr)	NOx Emissions (g/hr)	VOC Emissions (g/hr)	Fuel Consumption (gal/hr)
119	Augusta Rd.	69,995	13,618	16,222	1,001
2	S. Pleasantburg Dr.	26,525	5,161	6,147	379
3	Mauldin Rd.	68,551	13,338	15,887	981
4	US 276 (Laurens Rd.)	105,157	20,460	24,371	1,504
48	Woodruff Rd.	60,879	11,845	14,109	871
6	I-385	156,329	30,416	36,231	2,236
59	Pelham Rd.	136,264	26,512	31,581	1,949
8	SC 14	75,206	14,632	17,430	1,076
9	Aviation Dr.	37,300	7,257	8,645	534
10	Brockman-McClimon Rd.	62,383	12,137	14,458	892
80	SC 101	118,220	23,001	27,399	1,691
93	SC 290	126,489	24,610	29,315	1,810
101	US 29	98,772	19,217	22,891	1,413
113	SC 129	64,956	12,638	15,054	929
15	I-85 Business	56,968	11,084	13,203	815
	TOTAL	**1,263,993**	**245,927**	**292,943**	**18,083**

PM PEAK HOUR

Exhibit 23 shows a summary of the average delay time per vehicle and the average speed on a network-wide basis for the PM peak hour.

Exhibit 23: Existing (2010) PM Peak Hour Network Performance Summary

Existing (2010) PM Peak Hour NETWORK PERFORMANCE SUMMARY	
Parameter	Value
Average delay time per vehicle (seconds)	118.9703
Average speed (mph)	42.6985

Exhibit 24 shows a summary of emissions and fuel consumption for the study area during the PM peak hour. The data is broken down by interchange. In general, each interchange area extends approximately half the distance to the upstream and downstream interchanges.

Exhibit 24: Existing (2010) PM Peak Hour Emissions and Fuel Consumption Summary

Existing (2010) PM Peak Hour EMISSIONS AND FUEL CONSUMPTION SUMMARY					
Node ID	Interchange	CO Emissions (g/hr)	NOx Emissions (g/hr)	VOC Emissions (g/hr)	Fuel Consumption (gal/hr)
119	Augusta Rd.	83,336	16,214	19,314	1,192
2	S. Pleasantburg Dr.	31,984	6,223	7,412	458
3	Mauldin Rd.	78,805	15,333	18,264	1,127
4	US 276 (Laurens Rd.)	116,705	22,706	27,047	1,670
48	Woodruff Rd.	78,054	15,187	18,090	1,117
6	I-385	204,568	39,802	47,411	2,927
59	Pelham Rd.	143,512	27,922	33,260	2,053
8	SC 14	89,138	17,343	20,659	1,275
9	Aviation Dr.	47,173	9,178	10,933	675
10	Brockman-McClimon Rd.	77,529	15,084	17,968	1,109
80	SC 101	140,945	27,423	32,665	2,016
93	SC 290	141,824	27,594	32,869	2,029
101	US 29	111,975	21,786	25,951	1,602
113	SC 129	71,875	13,984	16,658	1,028
15	I-85 Business	23,960	4,662	5,553	343
	TOTAL	1,441,384	280,441	334,055	20,621

FREEWAY ANALYSIS

The following tables summarize the I-85 mainline LOS for each section along the freeway as well as the travel times between each interchange for the AM and PM peak hours. In general, the LOS, density, and average speed are shown for basic freeway segments.

AM PEAK HOUR

Exhibits 25 through 27 show the output data provided by the VISSIM modeling software for the AM peak hour.

Exhibit 25: Existing (2010) AM Peak Hour Freeway Level of Service Table

Existing (2010) AM Peak Hour I-85 Mainline Level of Service Table						
Section Description	SB			NB		
	Density (vpmpl)	Avg. Speed (mph)	LOS	Density (vpmpl)	Avg. Speed (mph)	LOS
Between I-85 Business Interchange and North End of Study	17.2	62.5	B	15.1	62.4	B
Between SC 129 and I-85 Business Interchange	15.4	61.4	B	14.4	61.0	B
Between US 29 and SC 129	21.6	59.9	C	17.7	61.1	B
Between SC 290 and US 29	21.8	59.8	C	17.2	61.4	B
Between SC 101 and SC 290	23.5	51.5	C	17.0	61.3	B
Between Brockman-McClimon Rd. and SC 101	21.6	59.6	C	15.2	61.2	B
Between Aviation Dr. and Brockman-McClimon Rd.	16.2	62.6	B	11.6	63.1	B
Between SC 14 and Aviation Dr.	14.1	62.5	B	9.7	62.3	A
Between Pelham Rd. and SC 14	69.2	29.1	F	16.9	60.3	B
Between I-385 and Pelham Rd.	98.1	11.6	F	59.5	24.5	F
Between Woodruff Rd. and I-385	11.4	48.6	B	11.1	62.6	B
Between Laurens Rd. and Woodruff Rd.	18.3	60.9	C	20.3	56.7	C
Between Mauldin Rd. & Laurens Rd.	21.1	59.2	C	20.7	59.0	C
Between Pleasantburg Dr. and Mauldin Rd.	13.7	62.6	B	12.4	63.1	B
Between Augusta Rd. and Pleasantburg Dr.	13.7	62.6	B	12.4	63.1	B
Between South End of Study and Augusta Rd.	16.1	61.2	B	12.4	63.1	B
Between I-85 Business Interchange and North End of Study	17.3	61.5	B	19.6	59.0	C

Exhibit 26: Existing (2010) AM Peak Hour I-85 NB Travel Times

Existing (2010) AM Peak Hour Northbound I-85 Travel Time			
TT Segment ID	Segment Label	Travel Time (sec.)	Average Speed (mph)
100	From South End of Study to Augusta Rd./Pleasantburg Dr./ Mauldin Rd. C-D off-ramp	72.8	60.9
101	From Augusta Rd./Pleasantburg Dr./Mauldin Rd. C-D off-ramp to C-D on-ramp	98.5	63.1
102	From Augusta Rd./Pleasantburg Dr./Mauldin Rd. C-D on-ramp to Laurens Rd. off-ramp	94.5	54.7
103	From Laurens Rd. off-ramp to on-ramp	16.0	61.1
104	From Laurens Rd. on-ramp to Woodruff Rd. off-ramp	106.6	57.6
105	From Woodruff Rd./I-385 C-D off-ramp to C-D on-ramp	64.2	62.2
106	From I-385 on-ramp to Pelham Rd. off-ramp	341.4	24.4
107	From Pelham Rd. off-ramp to on-ramp	47.5	57.8
108	From Pelham Rd. on-ramp to SC 14 off-ramp	76.9	60.2
109	From SC 14 off-ramp to Aviation Dr. on-ramp	84.6	62.2
110	From Aviation Dr. on-ramp to Brockman-McClimon Rd. off-ramp	38.9	63.1
111	From Brockman-McClimon Rd. off-ramp to on-ramp	52.0	62.2
112	From Brockman-McClimon Rd. on-ramp to SC 101 off-ramp	57.0	61.2
113	From SC 101 off-ramp to on-ramp	52.4	62.1
114	From SC 101 on-ramp to SC 290 off-ramp	152.6	60.3
115	From SC 290 off-ramp to on-ramp	51.1	61.3
116	From SC 290 on-ramp to US 29 off-ramp	109.5	60.0
117	From US 29 off-ramp to on-ramp	19.9	61.8
118	From US 29 on-ramp to SC 129 off-ramp	90.5	59.8
119	From SC 129 off-ramp to on-ramp	22.6	60.7
120	From SC 129 on-ramp to I-85 Bus. split	48.1	61.3
121	From I-85 Bus. split to North End of Study	40.6	61.8
	Total Travel Time (sec.)	**1738.4**	
	Total Travel Time (min.)	**29.0**	

Exhibit 27: Existing (2010) AM Peak Hour I-85 SB Travel Times

Existing (2010) AM Peak Hour SOUTHBOUND I-85 TRAVEL TIME			
TT Segment ID	Segment Label	Travel Time (sec.)	Average Speed (mph)
200	North End of study to I-85 Bus. on-ramp	42.4	59.9
201	I-85 Bus. on-ramp to SC 129 on-ramp	65.2	60.1
202	SC 129 on-ramp to US 29 off-ramp	95.2	59.4
203	US 29 off-ramp to on-ramp	8.1	60.3
204	US 29 on-ramp to SC 290 off-ramp	139.8	56.7
205	SC 290 off-ramp to on-ramp	48.7	60.6
206	SC 290 on-ramp to SC 101 off-ramp	168.9	56.7
207	SC 101 off-ramp to on-ramp	52.4	61.0
208	SC 101 on-ramp to Brockman-McClimon Rd. off-ramp	53.8	59.4
209	Brockman-McClimon Rd. off-ramp to on-ramp	49.5	60.8
210	Brockman-McClimon Rd. on-ramp to Aviation Dr. off-ramp	28.3	62.6
211	Aviation Dr. off-ramp to SC 14 on-ramp	101.5	56.4
212	SC 14 on-ramp to Pelham Rd. off-ramp	237.5	21.4
213	Pelham Rd. off-ramp to on-ramp	80.4	36.7
214	Pelham Rd. on-ramp to I-385/Woodruff Rd. C-D off-ramp	533.0	13.1
215	I-385/Woodruff Rd. C-D off-ramp to on-ramp	83.9	60.7
216	I-385/Woodruff Rd. C-D on-ramp to Laurens Rd. off-ramp	97.2	60.4
217	Laurens Rd. off-ramp to on-ramp	18.2	54.9
218	Laurens Rd. on-ramp to Augusta Rd./Pleasantburg Dr./Mauldin Rd. C-D off-ramp	95.1	58.7
219	Augusta Rd./Pleasantburg Dr./Mauldin Rd. C-D off-ramp to on-ramp	77.3	62.3
220	Augusta Rd./Pleasantburg Dr./Mauldin Rd. C-D on-ramp to South End of study	87.5	61.5
	Total Travel Time (sec.)	**2163.8**	
	Total Travel Time (min.)	**36.1**	

Exhibits 28 and 29 show the comparison between the VISSIM model simulation travel time along the I-85 freeway and the computed average travel time, as provided by the INRIX data. The graphs are shown for both the northbound and southbound directions in the AM peak hour.

Exhibit 28: Existing (2010) AM Peak Hour I-85 NB Travel Time Graph

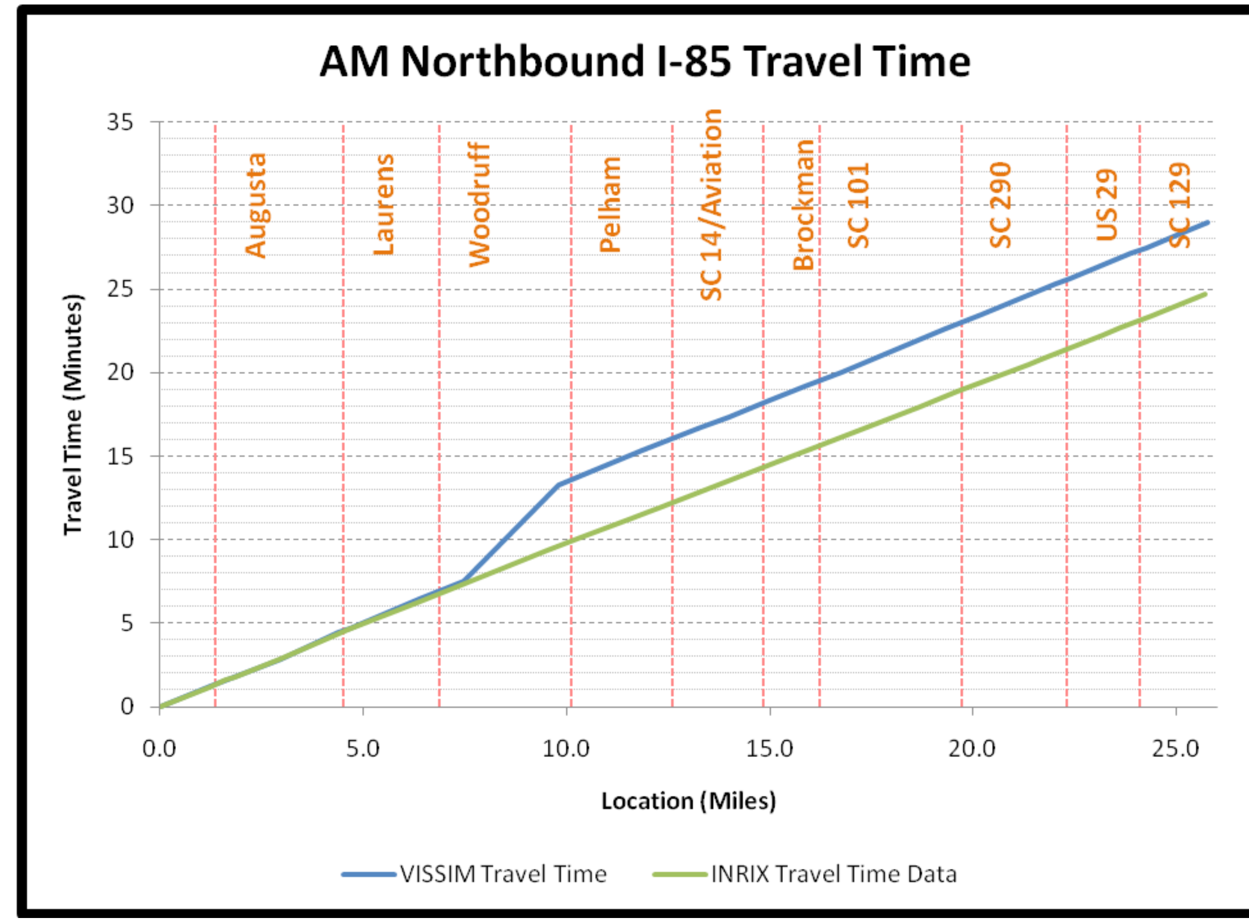
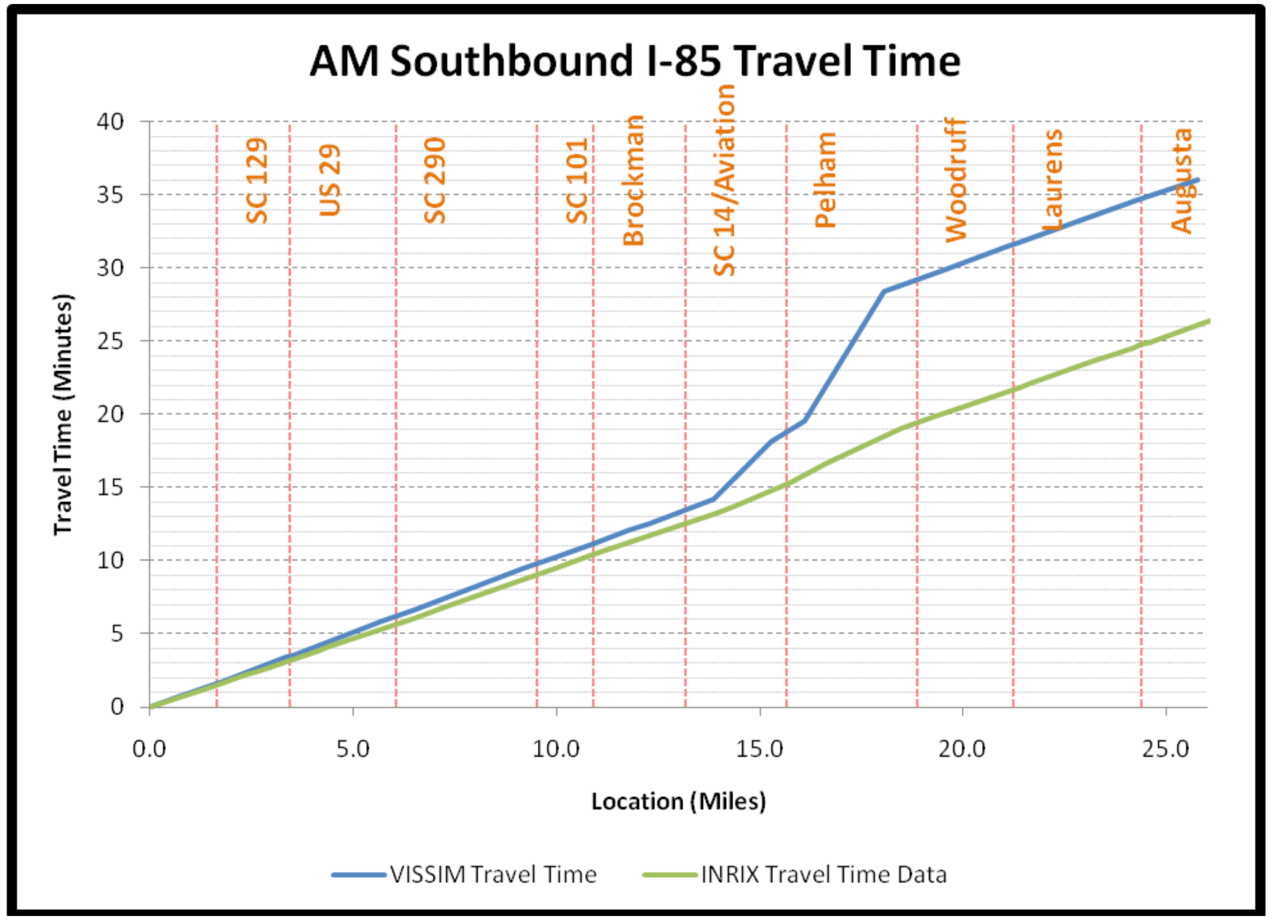


Exhibit 29: Existing (2010) AM Peak Hour I-85 SB Travel Time Graph



PM PEAK HOUR

Exhibits 30 through 32 show the output data provided by the VISSIM modeling software for the PM peak hour.

Exhibit 30: Existing (2010) PM Peak Hour Freeway Level of Service Table

Existing (2010) PM Peak Hour I-85 Mainline Level of Service Table						
	SB			NB		
Section Description	Density (vpmpl)	Avg. Speed (mph)	LOS	Density (vpmpl)	Avg. Speed (mph)	LOS
Between I-85 Business Interchange and North End of Study	18.0	57.8	C	17.3	61.5	B
Between SC 129 and I-85 Business Interchange	15.2	61.7	B	17.2	59.6	B
Between US 29 and SC 129	21.2	60.4	C	21.9	58.9	C
Between SC 290 and US 29	20.7	60.7	C	20.3	60.4	C
Between SC 101 and SC 290	27.0	50.1	D	21.3	59.8	C
Between Brockman-McClimon Rd. and SC 101	23.9	58.4	C	21.1	59.6	C
Between Aviation Dr. and Brockman-McClimon Rd.	17.5	62.5	B	15.2	62.7	B
Between SC 14 and Aviation Dr.	14.4	62.3	B	14.3	61.4	B
Between Pelham Rd. and SC 14	23.2	60.9	C	26.9	56.3	D
Between I-385 and Pelham Rd.	61.6	30.3	F	18.5	60.8	C
Between Woodruff Rd. and I-385	17.5	52.8	B	9.9	63.3	A
Between Laurens Rd. and Woodruff Rd.	25.8	57.5	C	18.3	58.7	C
Between Mauldin Rd. & Laurens Rd.	29.0	55.1	D	22.5	56.8	C
Between Pleasantburg Dr. and Mauldin Rd.	20.7	61.1	C	11.7	63.2	B
Between Augusta Rd. and Pleasantburg Dr.	20.7	61.1	C	11.7	63.2	B
Between South End of Study and Augusta Rd.	22.6	59.5	C	11.7	63.2	B
Between I-85 Business Interchange and North End of Study	25.7	59.3	C	18.2	59.5	C

* Section descriptions are defined as Interstate segments between interchange on-ramps and off-ramps.

Exhibit 31: Existing (2010) PM Peak Hour I-85 NB Travel Time

Existing (2010) PM Peak Hour NORTHBOUND I-85 TRAVEL TIME			
TT Segment ID	Segment Label	Travel Time (sec.)	Average Speed (mph)
100	From South End of Study to Augusta Rd./Pleasantburg Dr./ Mauldin Rd. C-D off-ramp	72.5	61.3
101	From Augusta Rd./Pleasantburg Dr./Mauldin Rd. C-D off-ramp to on-ramp	98.3	63.1
102	From Augusta Rd./Pleasantburg Dr./Mauldin Rd. C-D on-ramp to Laurens Rd. off-ramp	103.4	50.0
103	From Laurens Rd. off-ramp to on-ramp	16.1	60.8
104	From Laurens Rd. on-ramp to Woodruff Rd. off-ramp	103.9	59.1
105	From Woodruff Rd./I-385 C-D off-ramp to C-D on-ramp	64.2	62.3
106	From I-385 on-ramp to Pelham Rd. off-ramp	140.4	59.4
107	From Pelham Rd. off-ramp to on-ramp	46.6	59.0
108	From Pelham Rd. on-ramp to SC 14 off-ramp	84.5	54.8
109	From SC 14 off-ramp to Aviation Dr. on-ramp	86.0	61.2
110	From Aviation Dr. on-ramp to Brockman-McClimon Rd. off-ramp	39.1	62.8
111	From Brockman-McClimon Rd. off-ramp to on-ramp	54.1	59.8
112	From Brockman-McClimon Rd. on-ramp to SC 101 off-ramp	58.5	59.7
113	From SC 101 off-ramp to on-ramp	54.0	60.2
114	From SC 101 on-ramp to SC 290 off-ramp	158.8	58.0
115	From SC 290 off-ramp to on-ramp	52.8	59.3
116	From SC 290 on-ramp to US 29 off-ramp	112.0	58.7
117	From US 29 off-ramp to on-ramp	20.2	60.8
118	From US 29 on-ramp to SC 129 off-ramp	95.4	56.7
119	From SC 129 off-ramp to on-ramp	23.3	58.8
120	From SC 129 on-ramp to I-85 Bus. split	48.9	60.2
121	From I-85 Bus. split to North End of Study	41.3	60.8
	Total Travel Time (sec.)	**1574.3**	
	Total Travel Time (min.)	**26.2**	

Exhibit 32: Existing (2010) PM Peak Hour I-85 SB Travel Times

Existing (2010) AM Peak Hour SOUTHBOUND I-85 TRAVEL TIME			
TT Segment ID	Segment Label	Travel Time (sec.)	Average Speed (mph)
200	North End of study to I-85 Bus. on-ramp	42.4	59.9
201	I-85 Bus. on-ramp to SC 129 on-ramp	65.2	60.1
202	SC 129 on-ramp to US 29 off-ramp	95.2	59.4
203	US 29 off-ramp to on-ramp	8.1	60.3
204	US 29 on-ramp to SC 290 off-ramp	139.8	56.7
205	SC 290 off-ramp to on-ramp	48.7	60.6
206	SC 290 on-ramp to SC 101 off-ramp	168.9	56.7
207	SC 101 off-ramp to on-ramp	52.4	61.0
208	SC 101 on-ramp to Brockman-McClimon Rd. off-ramp	53.8	59.4
209	Brockman-McClimon Rd. off-ramp to on-ramp	49.5	60.8
210	Brockman-McClimon Rd. on-ramp to Aviation Dr. off-ramp	28.3	62.6
211	Aviation Dr. off-ramp to SC 14 on-ramp	101.5	56.4
212	SC 14 on-ramp to Pelham Rd. off-ramp	237.5	21.4
213	Pelham Rd. off-ramp to on-ramp	80.4	36.7
214	Pelham Rd. on-ramp to I-385/Woodruff Rd. C-D off-ramp	533.0	13.1
215	I-385/Woodruff Rd. C-D off-ramp to on-ramp	83.9	60.7
216	I-385/Woodruff Rd. C-D on-ramp to Laurens Rd. off-ramp	97.2	60.4
217	Laurens Rd. off-ramp to on-ramp	18.2	54.9
218	Laurens Rd. on-ramp to Augusta Rd./Pleasantburg Dr./Mauldin Rd. C-D off-ramp	95.1	58.7
219	Augusta Rd./Pleasantburg Dr./Mauldin Rd. C-D off-ramp to on-ramp	77.3	62.3
220	Augusta Rd./Pleasantburg Dr./Mauldin Rd. C-D on-ramp to South End of study	87.5	61.5
	Total Travel Time (sec.)	**2163.8**	
	Total Travel Time (min.)	**36.1**	

Exhibits 33 and 34 show the comparison between the VISSIM model simulation travel time along the I-85 freeway and the computed average travel time, as provided by the INRIX data. The graphs are shown for both the northbound and southbound directions in the PM peak hour.

Exhibit 33: Existing (2010) PM Peak Hour I-85 NB Travel Time Graph

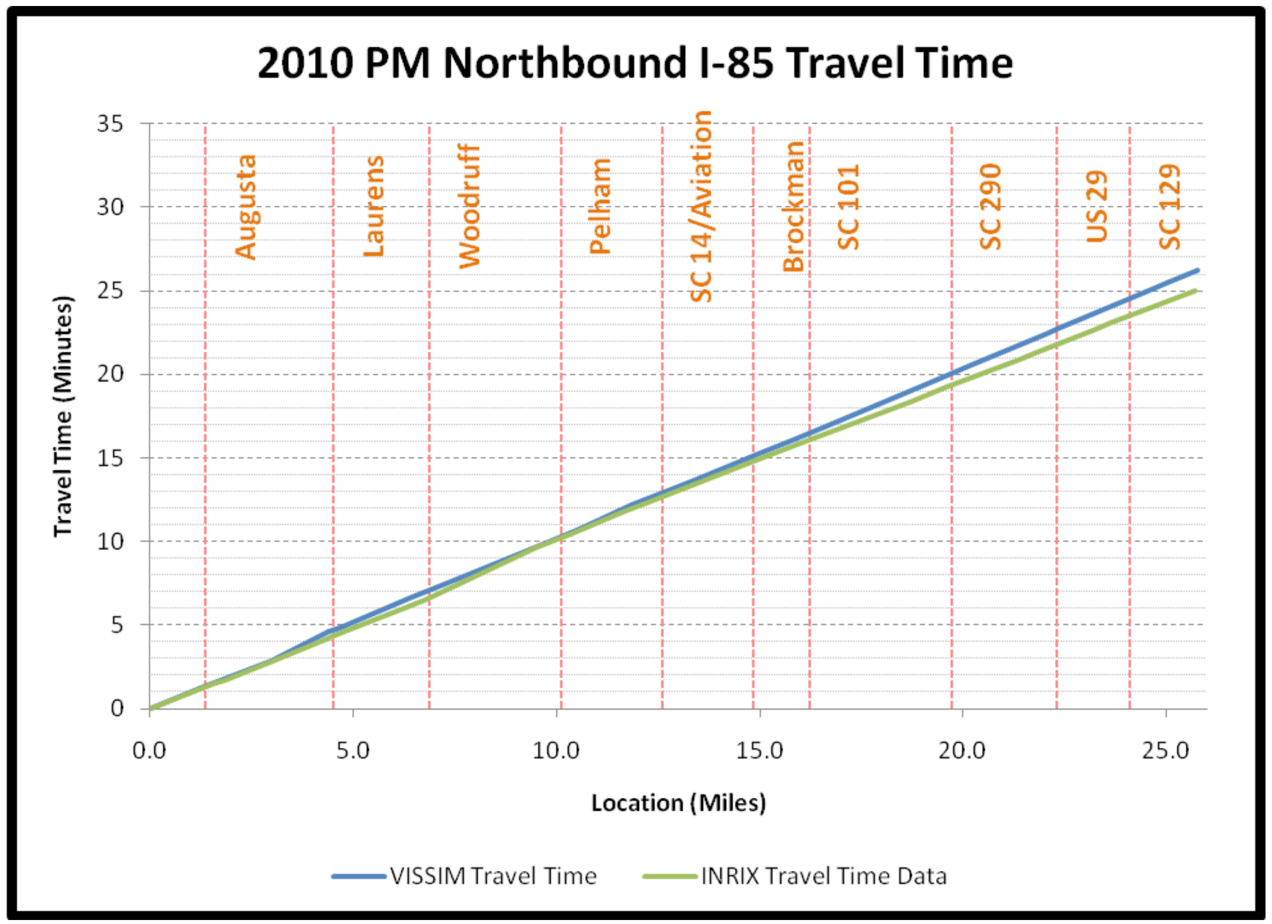
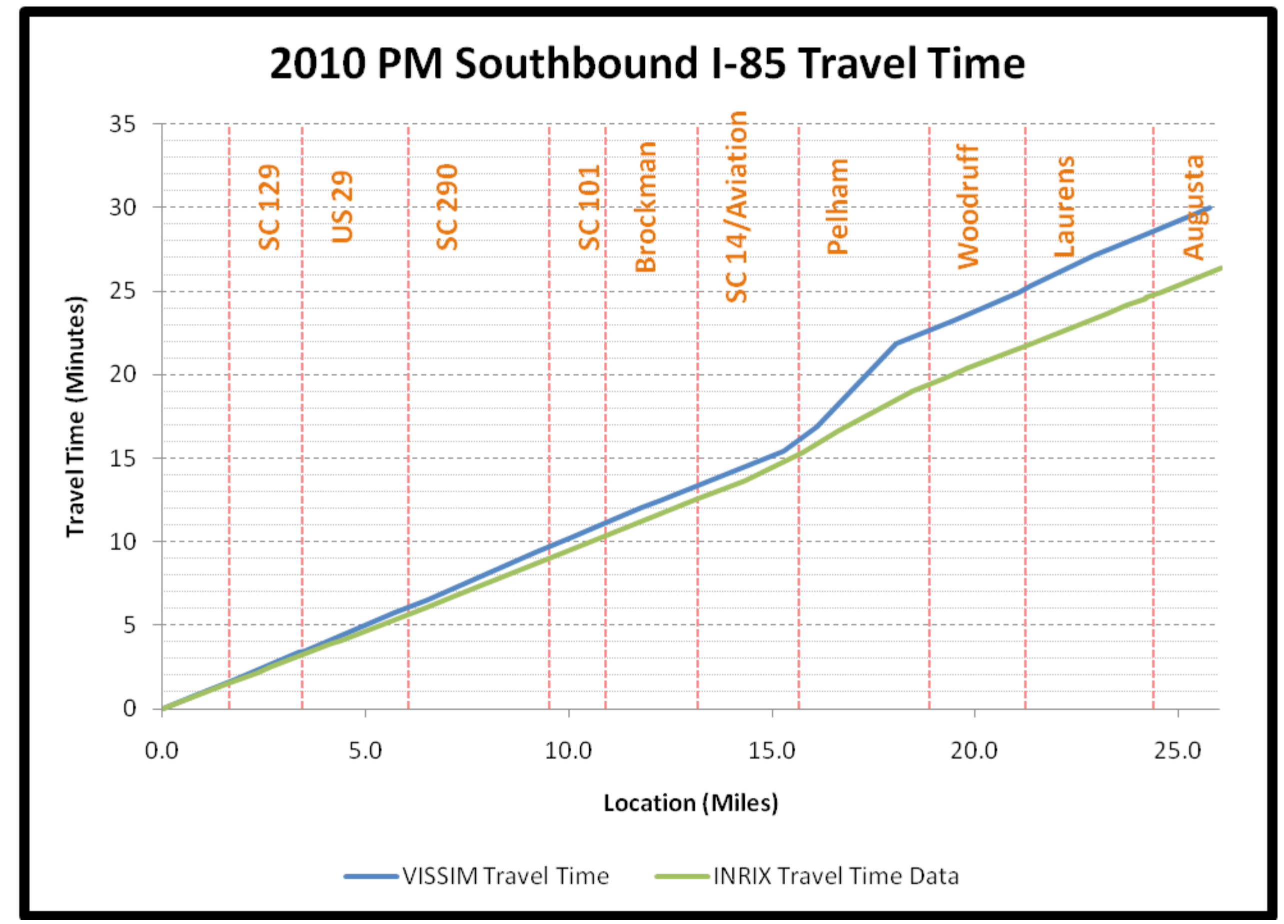


Exhibit 34: Existing (2010) PM Peak Hour I-85 SB Travel Time Graph



INTERSECTION ANALYSIS

The following tables summarize the intersection delay and LOS for each signalized and unsignalized intersection in the study area as well as the simulated and observed queue lengths for each intersection approach. These values are provided for both the AM and PM peak hours.

AM PEAK HOUR

Exhibits 35 through 37 show the output data provided by the VISSIM modeling software for the AM peak hour.

Exhibit 35: Existing (2010) AM Peak Hour Signalized Intersection LOS

EXISTING (2010) AM PEAK HOUR SIGNALIZED INTERSECTION DELAY & LOS				
NODE ID	INTERSECTION	VOLUME (VPH)	AVG. DELAY (SEC.)	LOS
17	Augusta Rd. @ Chalmers Rd.	1852	6.0	A
119	Augusta Rd. @ I-85 SB Ramps	1838	5.9	A
1	Augusta Rd. @ I-85 NB Ramps	1805	14.2	B
19	Augusta Rd. @ Woodmede Way	1388	11.5	B
28	Pleasantburg Dr. @ Chalmers Rd.	1753	12.5	B
27	Pleasantburg Dr. @ Impact Dr./Melvin Dr.	2593	5.9	A
120	Mauldin Rd. @ I-85 SB Ramps	2173	5.6	A
3	Mauldin Rd. @ I-85 NB Ramps	2719	9.7	A
36	Mauldin Rd. @ Parkins Mill Rd.	2629	11.2	B
43	US 276 (Laurens Rd.) @ Duvall Dr.	2471	9.7	A
49	Woodruff Rd. @ Woodruff Industrial Dr.	1320	4.6	A
122	Woodruff Rd. @ I-85 SB Ramps	1753	12.3	B
5	Woodruff Rd. @ I-85 NB Ramps	1909	17.0	B
48	Woodruff Rd. @ Carolina Point Pkwy./I-85 NB On-Ramp	1843	6.7	A
59	Pelham Rd. @ The Pkwy./I-85 SB On-Ramp	3213	79.7	E
123	Pelham Rd. @ I-85 SB Ramps	2770	62.2	E
7	Pelham Rd. @ I-85 NB Ramps	2919	37.9	D
64	Pelham Rd. @ Garlington Rd./Boland Ct.	2582	27.8	C
70	SC 14 @ Johns Rd.	3202	18.6	B
8	SC 14 @ I-85 Ramps	2434	38.0	D
84	SC 101 @ BMW Entrance/Caliber Ridge Rd.	2594	29.2	C
124	SC 101 @ I-85 SB Ramps	2138	12.7	B
11	SC 101 @ I-85 NB Ramps	2203	14.3	B
80	SC 101 @ Freeman Farm Rd./Plemmons Rd.	2396	10.5	B
93	SC 290 @ McAuley Rd.	3014	27.0	C
125	SC 290 @ I-85 SB Ramps	3923	39.3	D
12	SC 290 @ I-85 NB Ramps	3926	38.0	D
88	SC 290 @ Spartangreen Blvd.	3616	9.7	A
101	US 29 @ Nazareth Church Rd./Tyger Lake Dr.	1916	8.8	A

Exhibit 36: Existing (2010) AM Peak Hour Unsignalized Intersection LOS

Existing (2010) AM Peak Hour UNSIGNALIZED INTERSECTION DELAY & LOS			
Node ID	Intersection	Side Street Avg. Delay (sec.)	LOS
32	Mauldin Rd. @ N. Kings Rd.	25.6	D
40	US 276 (Laurens Rd.) @ Frontage Rd.	59.0	F
121	US 276 (Laurens Rd.) @ St. Joseph's Dr.	147.6	F
66	SC 14 @ E. Phillips Rd.	6.2	A
77	Brockman-McClimon Rd. Ramps @ Brockman-McClimon Rd.	10.6	B
104	US 29 @ Old Spartanburg Hwy.	11.2	B
126	US 29 @ I-85 SB Ramps	12.0	B
13	US 29 @ I-85 NB On-Ramp	8.7	A
97	US 29 @ I-85 NB Off-Ramp/New Hope Rd.	8.6	A
14	SC 129 @ I-85 NB Ramps	15.3	C
108	SC 129 @ Falling Creek Rd.	5.2	A
113	SC 129 @ Fort Prince Rd.	11.2	B
127	SC 129 @ I-85 SB Ramps	8.2	A

Exhibit 37: Existing (2010) AM Peak Hour Queue Summary

Existing (2010) AM Peak Hour QUEUE SUMMARY				
Node ID	Intersection	Approach	Average Queue (ft.)	Observed Queue
17	Augusta Rd. @ Chalmers Rd.	SB Augusta	3.7	Field observation confirms minimal queuing on all approaches
		WB Chalmers	28.9	
		NB Augusta	20.5	
119	Augusta Rd. @ I-85 SB Ramps	SB Off-Ramp	19.2	Field observation confirms minimal queuing on all approaches
		NB Augusta	3.4	
		SB Augusta	4.2	
1	Augusta Rd. @ I-85 NB Ramps	SB Augusta	4.9	Field observation confirms minimal queuing on all approaches
		NB Off-Ramp	77.7	
		NB Augusta	14.1	
19	Augusta Rd. @ Woodmede Way	WB Driveway	8.3	Field observation confirms minimal queuing on all approaches
		NB Augusta	6.2	
		EB Woodmede	62.9	
		SB Augusta	7.9	
28	Pleasantburg Dr. A Chalmers Rd.	EB Chalmers	85.6	Field observation confirms minimal queuing on all approaches
		SB Pleasantburg	6.0	
		NB Pleasantburg	10.8	
		WB Chalmers	2.3	
27	Pleasantburg Dr. @ Impact Dr./ Melvin Dr.	SB Pleasantburg	7.2	Field observation confirms minimal queuing on all approaches
		NB Pleasantburg	10.0	
		EB Impact	14.2	
		WB Melvin	8.7	
32	Mauldin Rd. @ N. Kings Rd.	EB Mauldin	0.0	Field observation confirms minimal queuing on all approaches
		SB Kings	25.8	
		WB Mauldin	0.7	
120	Mauldin Rd. @ I-85 SB Ramps	WB Mauldin	7.9	Field observation confirms minimal queuing on all approaches
		SB Off-Ramp	17.1	
		EB Mauldin	8.5	
3	Mauldin Rd. @ I-85 NB Ramps	NB Off-Ramp	20.1	Field observation confirms minimal queuing on all approaches
		EB Mauldin	45.4	
		WB Mauldin	26.2	
36	Mauldin Rd. @ Parkins Mill Rd.	WB Mauldin	18.2	Field observation confirms minimal queuing on all approaches
		EB Mauldin	55.2	
		SB Parkins Mill	124.9	

Exhibit 37: Existing (2010) AM Peak Hour Queue Summary Continued

Existing (2010) AM Peak Hour QUEUE SUMMARY				
Node ID	Intersection	Approach	Average Queue (ft.)	Observed Queue
43	US 276 (Laurens Rd.) @ Duvall Dr.	NB Duvall	52.0	Field observation confirms minimal queuing on all approaches
		WB Laurens	13.6	
		EB Laurens	24.6	
40	US 276 (Laurens Rd.) @ Frontage Rd.	SB Frontage	29.1	Field observation confirms minimal queuing on all approaches
		EB Laurens	37.9	
		WB Laurens	10.3	
121	US 276 (Laurens Rd.) @ St. Joseph's Dr.	EB Laurens	16.9	Field observation showed minor queuing on NB St. Joseph's approach
		NB St. Joseph's	1641.8	
		WB Laurens	78.7	
49	Woodruff Rd. @ Woodruff Industrial Dr.	NB Woodruff Industrial	11.3	Field observation confirms minimal queuing on all approaches
		EB Woodruff	3.4	
		SB Power Dr.	9.5	
		WB Woodruff	2.6	
122	Woodruff Rd. @ I-85 SB Ramps	SB Off-Ramp	34.5	Field observation confirms minimal queuing on all approaches
		EB Woodruff	9.5	
		WB Woodruff	13.0	
5	Woodruff Rd. @ I-85 NB Ramps	NB Off-Ramp	81.6	Field observation confirms slight queue on NB off-ramp
		EB Woodruff	4.6	
		WB Woodruff	10.7	
48	Woodruff Rd. @ Carolina Point Pkwy./I-85 NB On-Ramp	NB Carolina Point	22.5	Field observation confirms minimal queuing on all approaches
		WB Woodruff	8.3	
		EB Woodruff	255.3	
59	Pelham Rd. @ The Pkwy./I-85 SB On-Ramp	WB Pelham	175.4	Field observation showed congestion and queuing on EB Pelham approach and minimal queuing on SB Parkway approach
		EB Pelham	1650.0	
		SB The Pkwy.	1389.2	
123	Pelham Rd. @ I-85 SB Ramps	WB Pelham	59.5	Field observation confirms queue on SB off-ramp (~1600 ft.)
		SB Off-Ramp	1546.8	
		EB Pelham	83.3	
7	Pelham Rd. @ I-85 NB Ramps	NB Off-Ramp	1413.1	Field observation confirms queue on NB off-ramp (~1500 ft.)
		EB Pelham	35.3	
		WB Pelham	14.9	

Existing (2010) AM Peak Hour QUEUE SUMMARY				
Node ID	Intersection	Approach	Average Queue (ft.)	Observed Queue
64	Pelham Rd. @ Garlington Rd./ Boland Ct.	WB Pelham	22.0	Field observation confirms congestion and queuing on EB Pelham
		NB Garlington	253.0	
		SB Boland	14.5	
		EB Pelham	271.5	
70	SC 14 @ Johns Rd.	NB SC 14	29.8	Field observation confirms minimal queuing on all approaches
		EB Johns	167.0	
		WB Johns	21.8	
		SB SC 14	52.6	
8	SC 14 @ I-85 Ramps	NB SC 14	50.6	Field observation confirms minimal queuing on all approaches
		SB SC 14	291.7	
		SB Off-Ramp	44.6	
		NB Off-Ramp	89.4	
66	SC 14 @ E. Phillips Rd.	WB Phillips	0.0	Field observation confirms minimal queuing on all approaches
		EB Phillips	0.0	
		NB SC 14	0.0	
		SB SC 14	0.0	
77	Brockman-McClimon Rd. Ramps @ Brockman-McClimon Rd.	NB Brockman Ramps	0.0	Field observation confirms minimal queuing on all approaches
		EB Brockman	0.0	
		SB Brockman Ramps	0.0	
84	SC 101 @ BMW Entrance/ Caliber Ridge Rd.	WB SC 101	116.9	Field observation confirms minimal queuing on all approaches
		NB BMW Entrance	27.8	
		SB Caliber Ridge	32.5	
		EB SC 101	184.4	
124	SC 101 @ I-85 SB Ramps	SB Off-Ramp	71.2	Field observation confirms minimal queuing on all approaches
		EB SC 14	10.3	
		WB SC 14	9.6	
11	SC 101 @ I-85 NB Ramps	NB Off-Ramp	62.1	Field observation confirms minimal queuing on all approaches
		WB SC 101	12.3	
		EB SC 101	31.3	

Exhibit 37: Existing (2010) AM Peak Hour Queue Summary Continued

Existing (2010) AM Peak Hour QUEUE SUMMARY				
Node ID	Intersection	Approach	Average Queue (ft.)	Observed Queue
80	SC 101 @ Freeman Farm Rd./ Plemmons Rd.	SB Plemmons	46.8	Field observation confirms minimal queuing on all approaches
		NB Freeman Farm	19.5	
		EB SC 101	59.5	
		WB SC 101	25.7	
93	SC 290 @ McAuley Rd.	NB McAuley	8.8	Field observation confirms minimal queuing on all approaches
		SB McAuley	110.2	
		EB SC 290	52.4	
		WB SC 290	101.7	
125	SC 290 @ I-85 SB Ramps	SB Off-Ramp	228.0	Field observation confirms minimal queuing on all approaches
		EB SC 290	258.1	
		WB SC 290	130.1	
12	SC 290 @ I-85 NB Ramps	NB Off-Ramp	30.5	Field observation confirms slight queuing on NB Off-Ramp
		WB SC 290	190.4	
		EB SC 290	225.3	
88	SC 290 @ Spartangreen Blvd.	EB SC 290	33.4	Field observation confirms minimal queuing on all approaches
		SB Spartangreen	11.2	
		NB Driveway	20.1	
		WB SC 290	30.8	
104	US 29 @ Old Spartanburg Hwy.	WB US 29	0.0	Field observation confirms minimal queuing on all approaches
		EB US 29	0.0	
		NB Old Spartanburg	201.5	
		SB Syphint	0.1	
126	US 29 @ I-85 SB Ramps	SB Off-Ramp	0.0	Field observation confirms minimal queuing on all approaches
		WB US 29	0.0	
		EB US 29	0.0	
13	US 29 @ I-85 NB On-Ramp	EB US 29	0.0	Field observation confirms minimal queuing on all approaches
		WB US 29	0.2	
97	US 29 @ I-85 NB Off-Ramp/New Hope Rd.	NB Off-Ramp	0.0	Field observation confirms minimal queuing on all approaches
		EB US 29	0.0	
		WB US 29	0.0	
		SB New Hope	0.0	

Existing (2010) AM Peak Hour QUEUE SUMMARY				
Node ID	Intersection	Approach	Average Queue (ft.)	Observed Queue
101	US 29 @ Nazareth Church Rd./ Tyger Lake Dr.	EB US 29	0.2	Field observation confirms minimal queuing on all approaches
		NB Nazareth Church	6.5	
		WB US 29	10.1	
		SB Tyger Lake	1.6	
113	SC 129 @ Fort Prince Rd.	EB SC 129	0.0	Field observation confirms minimal queuing on all approaches
		WB SC 129	0.0	
		SB Fort Prince	0.0	
127	SC 129 @ I-85 SB Ramps	SB Off-Ramp	0.0	Field observation confirms minimal queuing on all approaches
		WB SC 129	0.0	
		EB SC 129	0.0	
14	SC 129 @ I-85 NB Ramps	WB SC 129	0.1	Field observation confirms minimal queuing on all approaches
		NB Off-Ramp	8.4	
		EB SC 129	0.1	
108	SC 129 @ Falling Creek Rd.	SB Falling Creek	2.1	Field observation confirms minimal queuing on all approaches
		NB Falling Creek	0.2	
		EB SC 129	14.8	

PM PEAK HOUR

Exhibits 38 through 40 show the output data provided by the VISSIM modeling software for the PM peak hour.

Exhibit 38: Existing (2010) PM Peak Hour Signalized Intersection LOS

Existing (2010) PM Peak Hour SIGNALIZED INTERSECTION DELAY & LOS				
Node ID	Intersection	Volume (vph)	Avg. Delay (sec.)	LOS
17	Augusta Rd. @ Chalmers Rd.	1720	5.1	A
119	Augusta Rd. @ I-85 SB Ramps	1863	10.0	A
1	Augusta Rd. @ I-85 NB Ramps	1705	8.1	A
19	Augusta Rd. @ Woodmede Way	1666	14.1	B
28	Pleasantburg Dr. @ Chalmers Rd.	1955	8.4	A
27	Pleasantburg Dr. @ Impact Dr./Melvin Dr.	3110	7.2	A
120	Mauldin Rd. @ I-85 SB Ramps	1905	4.5	A
3	Mauldin Rd. @ I-85 NB Ramps	2707	7.3	A
36	Mauldin Rd. @ Parkins Mill Rd.	2620	10.5	B
43	US 276 (Laurens Rd.) @ Duvall Dr.	2540	30.4	C
49	Woodruff Rd. @ Woodruff Industrial Dr.	2508	25.6	C
122	Woodruff Rd. @ I-85 SB Ramps	2875	24.4	C
5	Woodruff Rd. @ I-85 NB Ramps	2198	19.0	B
48	Woodruff Rd. @ Carolina Point Pkwy./I-85 NB On-Ramp	1976	9.8	A
59	Pelham Rd. @ The Pkwy./I-85 SB On-Ramp	3194	33.7	C
123	Pelham Rd. @ I-85 SB Ramps	2320	25.4	C
7	Pelham Rd. @ I-85 NB Ramps	2841	24.1	C
64	Pelham Rd. @ Garlington Rd./Boland Ct.	2594	21.6	C
70	SC 14 @ Johns Rd.	3447	18.0	B
8	SC 14 @ I-85 Ramps	2772	31.6	C
84	SC 101 @ BMW Entrance/Caliber Ridge Rd.	2456	26.0	C
124	SC 101 @ I-85 SB Ramps	1928	11.9	B
11	SC 101 @ I-85 NB Ramps	2037	14.1	B
80	SC 101 @ Freeman Farm Rd./Plemmons Rd.	2222	10.2	B
93	SC 290 @ McAuley Rd.	2447	17.5	B
125	SC 290 @ I-85 SB Ramps	3132	31.5	C
12	SC 290 @ I-85 NB Ramps	3556	29.6	C
88	SC 290 @ Spartangreen Blvd.	3177	8.8	A
101	US 29 @ Nazareth Church Rd./Tyger Lake Dr.	2633	12.5	B

Exhibit 39: Existing (2010) PM Peak Hour Unsignalized Intersection LOS

Existing (2010) PM Peak Hour UNSIGNALIZED INTERSECTION DELAY & LOS			
Node ID	Intersection	Side Street Avg. Delay (sec.)	LOS
32	Mauldin Rd. @ N. Kings Rd.	16.5	C
40	US 276 (Laurens Rd.) @ Frontage Rd.	650.2	F
121	US 276 (Laurens Rd.) @ St. Joseph's Dr.	152.2	F
66	SC 14 @ E. Phillips Rd.	7.4	A
77	Brockman-McClimon Rd. Ramps @ Brockman-McClimon Rd.	7.8	A
104	US 29 @ Old Spartanburg Hwy.	11.6	B
126	US 29 @ I-85 SB Ramps	14.0	B
13	US 29 @ I-85 NB On-Ramp	7.4	A
97	US 29 @ I-85 NB Off-Ramp/New Hope Rd.	21.3	C
14	SC 129 @ I-85 NB Ramps	9.4	A
108	SC 129 @ Falling Creek Rd.	3.6	A
113	SC 129 @ Fort Prince Rd.	9.2	A
127	SC 129 @ I-85 SB Ramps	9.5	A

Exhibit 40: Existing (2010) PM Peak Hour Queue Summary

Existing (2010) PM Peak Hour QUEUE SUMMARY				
Node ID	Intersection	Approach	Average Queue (ft.)	Observed Queue
17	Augusta Rd. @ Chalmers Rd.	SB Augusta	4.9	Field observation confirms minimal queuing on all approaches
		WB Chalmers	23.3	
		NB Augusta	6.5	
119	Augusta Rd. @ I-85 SB Ramps	SB Off-Ramp	45.9	Field observation confirms minimal queuing on all approaches
		NB Augusta	6.9	
		SB Augusta	10.9	
1	Augusta Rd. @ I-85 NB Ramps	SB Augusta	3.7	Field observation confirms minimal queuing on all approaches
		NB Off-Ramp	40.2	
		NB Augusta	4.6	
19	Augusta Rd. @ Woodmede Way	WB Driveway	4.3	Field observation confirms minimal queuing on all approaches
		NB Augusta	10.9	
		EB Woodmede	88.5	
		SB Augusta	13.1	
28	Pleasantburg Dr. @ Chalmers Rd.	EB Chalmers	33.6	Field observation confirms minimal queuing on all approaches
		SB Pleasantburg	8.4	
		NB Pleasantburg	9.9	
		WB Chalmers	5.1	
27	Pleasantburg Dr. @ Impact Dr./ Melvin Dr.	SB Pleasantburg	12.5	Field observation confirms minimal queuing on all approaches
		NB Pleasantburg	14.1	
		EB Impact	24.5	
		WB Melvin	10.0	
32	Mauldin Rd. @ N. Kings Rd.	EB Mauldin	0.0	Field observation confirms minimal queuing on all approaches
		SB Kings	2.3	
		WB Mauldin	0.2	
120	Mauldin Rd. @ I-85 SB Ramps	WB Mauldin	4.1	Field observation confirms minimal queuing on all approaches
		SB Off-Ramp	9.7	
		EB Mauldin	9.0	
3	Mauldin Rd. @ I-85 NB Ramps	NB Off-Ramp	18.1	Field observation confirms minimal queuing on all approaches
		EB Mauldin	45.1	
		WB Mauldin	13.8	
36	Mauldin Rd. @ Parkins Mill Rd.	WB Mauldin	11.0	Field observation confirms minimal queuing on all approaches
		EB Mauldin	20.9	
		SB Parkins Mill	99.5	

Existing (2010) PM Peak Hour QUEUE SUMMARY				
Node ID	Intersection	Approach	Average Queue (ft.)	Observed Queue
43	US 276 (Laurens Rd.) @ Duvall Dr.	NB Duvall	307.9	Field observation confirms minimal queuing on all approaches
		WB Laurens	17.4	
		EB Laurens	397.4	
40	US 276 (Laurens Rd.) @ Frontage Rd.	SB Frontage	529.4	Field observation confirms slight queue on SB Frontage Rd.
		EB Laurens	4.0	
		WB Laurens	0.7	
121	US 276 (Laurens Rd.) @ St. Joseph's Dr.	EB Laurens	49.7	Field observation shows minor queuing on NB St. Joseph's approach
		NB St. Joseph's	1009.6	
		WB Laurens	17.2	
49	Woodruff Rd. @ Woodruff Industrial Dr.	NB Woodruff Industrial	142.0	Field observation confirms minimal queuing on all approaches
		EB Woodruff	73.4	
		SB Power Dr.	48.8	
		WB Woodruff	47.2	
122	Woodruff Rd. @ I-85 SB Ramps	SB Off-Ramp	40.0	Field observation confirms minimal queuing on all approaches
		EB Woodruff	102.3	
		WB Woodruff	147.9	
5	Woodruff Rd. @ I-85 NB Ramps	NB Off-Ramp	99.1	Field observation confirms slight queue on NB off-ramp
		EB Woodruff	16.8	
		WB Woodruff	30.8	
48	Woodruff Rd. @ Carolina Point Pkwy./I-85 NB On-Ramp	NB Carolina Point	44.7	Field observation confirms minimal queuing on all approaches
		WB Woodruff	8.6	
		EB Woodruff	143.5	
59	Pelham Rd. @ The Pkwy./I-85 SB On-Ramp	WB Pelham	72.4	Field observation confirms queuing on EB Pelham Rd.
		EB Pelham	307.6	
		SB The Pkwy.	425.4	
123	Pelham Rd. @ I-85 SB Ramps	WB Pelham	258.7	Field observation confirms queuing on Pelham Rd.
		SB Off-Ramp	163.8	
		EB Pelham	133.1	
7	Pelham Rd. @ I-85 NB Ramps	NB Off-Ramp	323.0	Field observation confirms queuing on Pelham Rd. and I-85 NB Off-Ramp
		EB Pelham	228.2	
		WB Pelham	47.6	

Exhibit 40: Existing (2010) PM Peak Hour Queue Summary Continued

Existing (2010) PM Peak Hour Queue Summary				
Node ID	**Intersection**	**Approach**	**Average Queue (ft.)**	**Observed Queue**
64	Pelham Rd. @ Garlington Rd./ Boland Ct.	WB Pelham	61.7	Field observation confirms minimal queuing on all approaches
		NB Garlington	151.3	
		SB Boland	18.2	
		EB Pelham	126.9	
70	SC 14 @ Johns Rd.	NB SC 14	116.6	Field observation confirms minimal queuing on all approaches
		EB Johns	15.9	
		WB Johns	39.6	
		SB SC 14	42.0	
8	SC 14 @ I-85 Ramps	NB SC 14	51.7	Field observation confirms minimal queuing on all approaches
		SB SC 14	44.8	
		SB Off-Ramp	41.3	
		NB Off-Ramp	140.5	
66	SC 14 @ E. Phillips Rd.	WB Phillips	0.0	Field observation confirms minimal queuing on all approaches
		EB Phillips	0.0	
		NB SC 14	0.0	
		SB SC 14	0.0	
77	Brockman-McClimon Rd. Ramps @ Brockman-McClimon Rd.	NB Brockman Ramps	0.0	Field observation confirms minimal queuing on all approaches
		EB Brockman	0.0	
		SB Brockman Ramps	0.0	
84	SC 101 @ BMW Entrance/ Caliber Ridge Rd.	WB SC 101	79.0	Field observation confirms minimal queuing on all approaches
		NB BMW Entrance	41.3	
		SB Caliber Ridge	25.9	
		EB SC 101	70.6	
124	SC 101 @ I-85 SB Ramps	SB Off-Ramp	73.3	Field observation confirms minimal queuing on all approaches
		EB SC 14	6.0	
		WB SC 14	3.9	
11	SC 101 @ I-85 NB Ramps	NB Off-Ramp	47.4	Field observation confirms minimal queuing on all approaches
		WB SC 101	8.3	
		EB SC 101	27.9	

Existing (2010) PM Peak Hour Queue Summary				
Node ID	**Intersection**	**Approach**	**Average Queue (ft.)**	**Observed Queue**
80	SC 101 @ Freeman Farm Rd./ Plemmons Rd.	SB Plemmons	81.2	Field observation confirms minimal queuing on all approaches
		NB Freeman Farm	46.3	
		EB SC 101	40.0	
		WB SC 101	7.1	
93	SC 290 @ McAuley Rd.	NB McAuley	37.4	Field observation confirms minimal queuing on all approaches
		SB McAuley	56.0	
		EB SC 290	39.9	
		WB SC 290	35.8	
125	SC 290 @ I-85 SB Ramps	SB Off-Ramp	65.9	Field observation confirms slight queuing on SC 290
		EB SC 290	138.4	
		WB SC 290	153.0	
12	SC 290 @ I-85 NB Ramps	NB Off-Ramp	30.9	Field observation confirms slight queuing on SC 290
		WB SC 290	202.8	
		EB SC 290	110.0	
88	SC 290 @ Spartangreen Blvd.	EB SC 290	10.1	Field observation confirms minimal queuing on all approaches
		SB Spartangreen	40.0	
		NB Driveway	36.8	
		WB SC 290	12.7	
104	US 29 @ Old Spartanburg Hwy.	WB US 29	0.0	Field observation confirms minimal queuing on all approaches
		EB US 29	0.0	
		NB Old Spartanburg	0.0	
		SB Syphint	0.0	
126	US 29 @ I-85 SB Ramps	SB Off-Ramp	0.0	Field observation confirms minimal queuing on all approaches
		WB US 29	0.0	
		EB US 29	0.0	
13	US 29 @ I-85 NB On-Ramp	EB US 29	0.0	Field observation confirms minimal queuing on all approaches
		WB US 29	26.6	
97	US 29 @ I-85 NB Off-Ramp/New Hope Rd.	NB Off-Ramp	0.0	Field observation confirms minimal queuing on all approaches
		EB US 29	0.0	
		WB US 29	0.0	
		SB New Hope	0.0	

Exhibit 40: Existing (2010) PM Peak Hour Queue Summary Continued

Existing (2010) PM Peak Hour QUEUE SUMMARY				
Node ID	Intersection	Approach	Average Queue (ft.)	Observed Queue
101	US 29 @ Nazareth Church Rd./ Tyger Lake Dr.	EB US 29	0.0	Field observation confirms minimal queuing on all approaches
		NB Nazareth Church	15.0	
		WB US 29	28.9	
		SB Tyger Lake	3.2	
113	SC 129 @ Fort Prince Rd.	EB SC 129	0.0	Field observation confirms minimal queuing on all approaches
		WB SC 129	0.0	
		SB Fort Prince	0.0	
127	SC 129 @ I-85 SB Ramps	SB Off-Ramp	0.0	Field observation confirms minimal queuing on all approaches
		WB SC 129	0.0	
		EB SC 129	0.0	
14	SC 129 @ I-85 NB Ramps	WB SC 129	0.8	Field observation confirms minimal queuing on all approaches
		NB Off-Ramp	1.0	
		EB SC 129	0.0	
108	SC 129 @ Falling Creek Rd.	SB Falling Creek	5.7	Field observation confirms minimal queuing on all approaches
		NB Falling Creek	0.4	
		EB SC 129	0.1	

Chapter 5: Traffic Safety and Operational Issues

5.1 I-85 MAINLINE

The mainline of I-85 presently operates at an acceptable level of service for the majority of the study area, with the exception of the section between US 276 (Laurens Road) and SC 14. The primary factors affecting the level of service in this section are the heavy entering and exiting volumes at I-385 and the heavy volumes at I-85 and Pelham Road.

In 2035 under the No Build scenario, the expected level of service drops severely in the area of I-385 and Pelham Road. As a result, the majority of the mainline operates at a level of service D or worse. As expected, the section between Laurens Road and SC 14 remains the most deficient with much of the section operating at a LOS F.

5.2 INTERCHANGES

There are 15 interchanges in the 22 mile corridor study area. Most of the interchanges function at a high level of service without major operational issues.

The interchanges with Augusta Road, SC 291 (S. Pleasantburg Drive) and Mauldin Road were reconstructed in the early 1990s utilizing CD roads. These interchanges operate at a high level of service with the exception of the entrance ramp from Augusta Road to I-85 southbound and the entrance ramp from the CD road to I-85 northbound.

The interchange of I-85 and US 276 (Laurens Road) is a full cloverleaf design with I-85 crossing over US 276. The current design operates relatively well from a capacity standpoint since ramp volumes are relatively low. There are safety concerns at the interchange due to the high speed weaving sections on I-85.

The interchange of I-85, I-385 and Woodruff Road is currently under re-design under a separate contract. This interchange is a major system to system interchange that utilizes CD roads and also accommodates Woodruff Road traffic. Due to the heavy entering and exiting volumes in the area the mainline operates at a LOS F in the interchange area.

I-85 at Pelham Road is a major interchange with significant entering and exiting volumes. Off ramp queue lengths are excessive and routinely back up onto the interstate in the current year. The ramp terminals operate at a poor level of service due to the heavy turning volumes.

The remaining interchanges operate at an acceptable level of service in the current year. With the exception of the interchange of I-85 and SC 290. There are currently high volumes of truck traffic utilizing the interchange due to several manufacturing plants on the east side of the interchange and several truck stops on the west side of the interchange creating a large number of turning trucks and significant backups at the entrance and exit ramps.

5.3 RAMPS

Several entrance and exit ramps are substandard in length according to current design standards. In particular:

- Acceleration lane southbound at Augusta Road
- All acceleration and deceleration lanes at Laurens Road
- Deceleration lanes at SC 101
- Deceleration lanes at SC 290
- Acceleration and deceleration lanes at US 29
- Acceleration and deceleration lanes at SC 129

Other ramp improvements that should be considered are the need for two-lane exits at Pelham Road and at I-385.

5.4 SIGNING

As indicated previously I-85 was upgraded between Augusta Road and Mauldin Road. During this upgrade the signing was improved and is in good condition. From Mauldin Road to the north end of the corridor many of the signs do not meet current standards. In keeping with the new Manual on Uniform Traffic Control Devices (MUTCD), the existing signs should be replaced with overhead structures and in some cases the new "arrow per lane" signs which are easier for unfamiliar motorists to comprehend.

5.5 CRASH ANALYSIS AND SAFETY CONCERNS

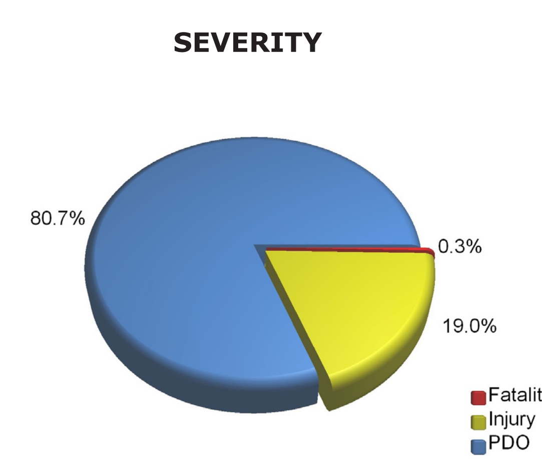
This 22-mile corridor of I-85 experienced a total of 2,153 crashes in just over three years from January 1, 2007 to May 1, 2010 according to records obtained from the Department of Public Safety. There were a total of seven fatal crashes recorded with a total of nine deaths. A review of the fatal crash locations indicate that four of the crashes were in the northbound lane and three in the southbound lane. There were five fatal crashes in the five-mile segment between Batesville Road and SC 101; however there does not appear to be any correlation between the crashes. One fatal crash occurred on the CD road between Mauldin Road and Augusta Road and one at the acceleration lane from Laurens Road to southbound I-85.

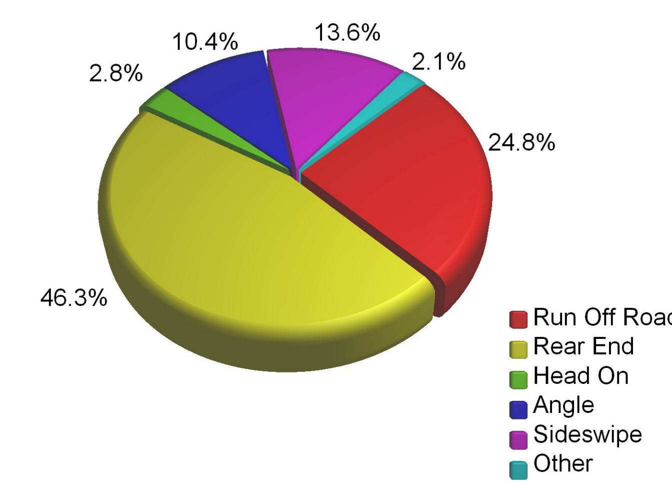
A review of the crash rates for this segment of I-85 for the two-year period ending December 2010 reveals that crash rates are higher than for the statewide interstate system, which includes both rural and urban interstate routes. As shown below, crash rates for I-85 are slightly less, but similar to more urban interstates with average daily traffic over 70,000 vehicles per day.

	TOTAL CRASHES	FATAL CRASHES	INJURY CRASHES
I-85 Corridor (US 25 to SC 129)	59.98 per mile	0.16 per mile	11.77 per mile
Statewide Average for Interstates	23.89 per mile	0.19 per mile	5.10 per mile
Urban Interstates (ADT > 70,000 vpd)	65.60 per mile	0.20 per mile	14.02 per mile

Exhibit 41 breaks down the crashes by severity and type. Just over 80% of the total accidents involved property damage only. Accidents with injuries accounted for 19% of the crashes. Three out of every 1,000 crashes (0.3%) resulted in fatalities. The high percentage of property damage only crashes is indicative of heavy traffic and congested roadways.

Exhibit 41: Crashes by Severity and Type





The most common accident on I-85 is the "rear end" crash, accounting for 46% of all accidents. The "run off the road" accident is the second most common accounting for nearly 25% of the accidents. The majority of the "run off the road" accidents are likely the result of maneuvers by the driver to avoid a "rear end" crash. Together, the "run off the road" and the "rear end" accidents contribute to 71% of all crashes. The third most common accident is the "sideswipe" at almost 14%. Approximately 85% of all accidents are encompassed in these three types of crashes. These type accidents result from stop and go traffic conditions and the lane changing/merging maneuvers that are common to roads that exhibit heavy congestion.

There are several areas of concern between Laurens Road and Pelham Road. Exhibit 42 shows crash concentrations with the locations referenced by mile post. At Laurens Road, the existing full cloverleaf interchange requires traffic entering and exiting the freeway to weave on the bridges over Laurens Road. This is true for both the northbound and southbound lanes of I-85. These sections of high speed weaving on the mainline experienced several crashes and as volumes increase the potential for crashes will also increase.

The I-385 interchange exhibits high levels of crashes at most ramps, both merging and diverging. Several of the ramps experience relatively high crashes due to substandard geometrics. The area between I-385 and Pelham Road experiences the highest numbers of crashes, primarily rear end and sideswipe crashes due to severe congestion in the peak traffic periods. At I-85 and Pelham Road there are a high number of rear end and sideswipe crashes due to the extreme congestion in the area. High levels of crashes are being experienced on Pelham Road at the ramp terminals due to heavy turning and merging volumes. The areas of concentrated crashes between Woodruff Road and Pelham Road are shown in Exhibit 43.

The only other significant spike in crashes as shown in Exhibit 42 is at the I-85 and SC 290 interchange which experiences a high level of truck traffic due to several manufacturing plants on the east side of the interchange and several truck stops on the west side of the interchange.

The remainder of the corridor experiences isolated areas of crashes at ramps as well as random locations, which is consistent with the expectations for a high volume freeway.

Exhibit 42: Crash Concentrations between White Horse Road and Fort Prince Boulevard

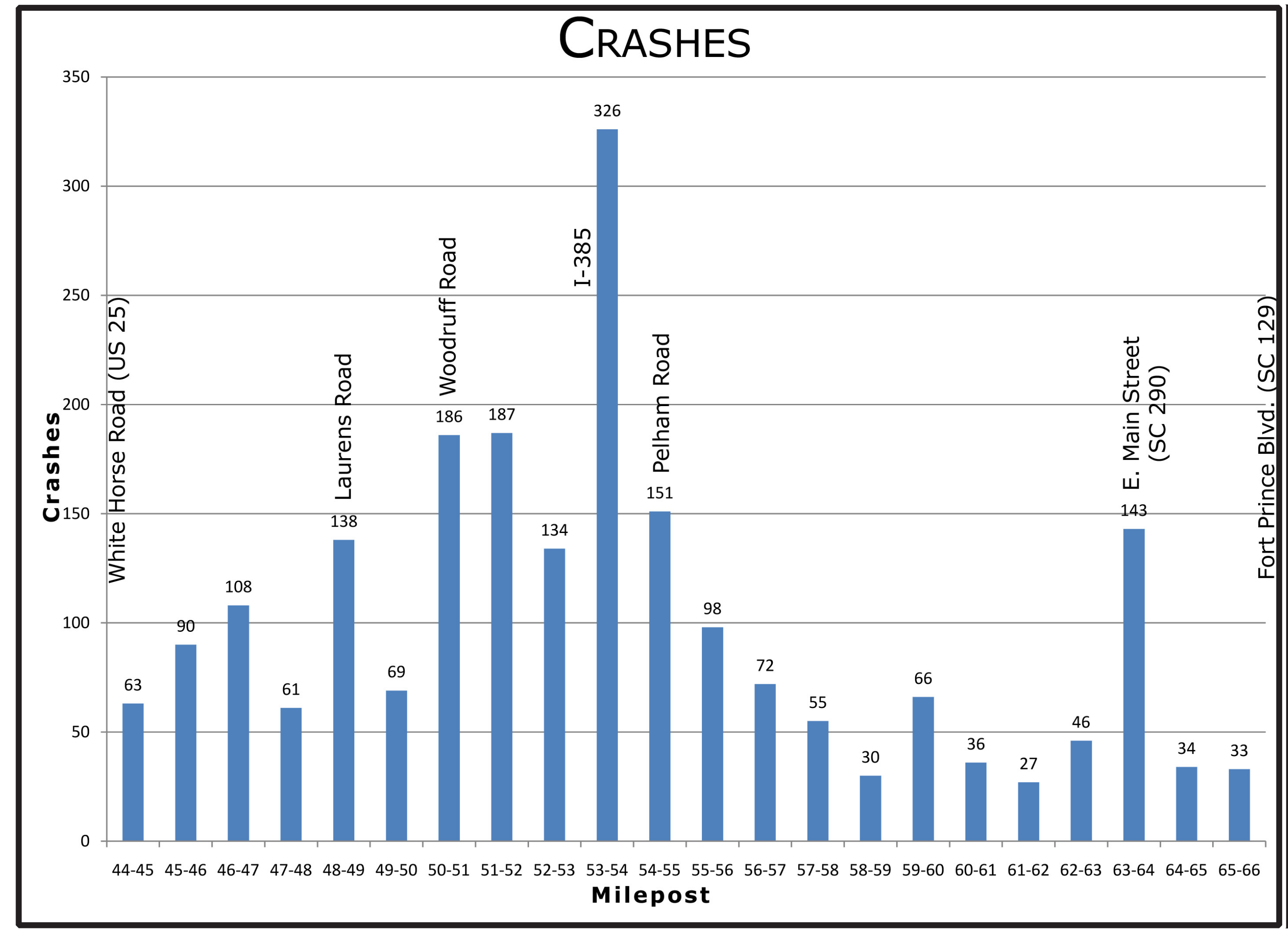
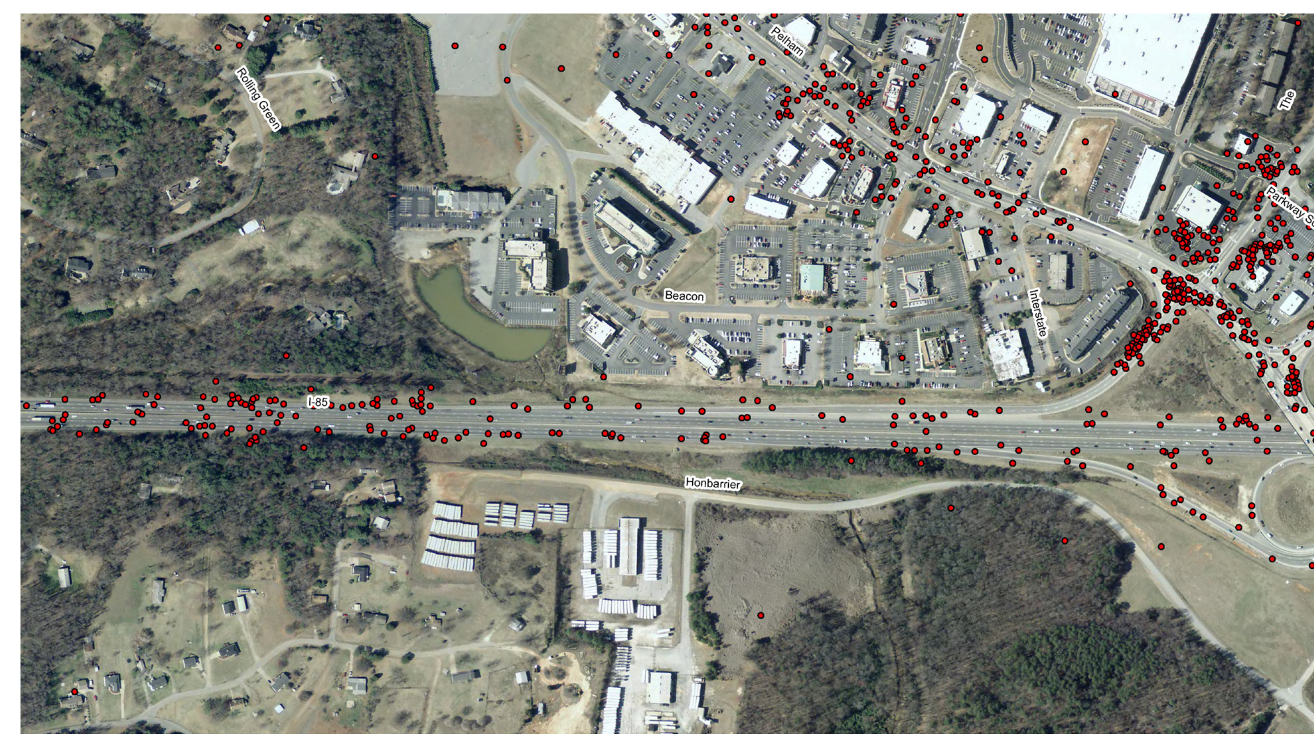


Exhibit 43: Accidents Woodruff Road to Pelham Road (January 2007 to May 2010)

South of I-385

North of I-385

Between I-385 and Pelham Road



South of Pelham Road

Chapter 6: Engaging the I-85 Partners

Traffic conditions and any future improvements on I-85 impact the quality of life, economic opportunities, and commerce along the corridor. An important component of this study has been public participation. Those living, working, or traveling in the area have first-hand experience with travel conditions on I-85 and have valuable insights to potential solutions to current and future traffic operations along the study corridor. The importance of engaging the community in planning the future of I-85 cannot be underestimated as the corridor impacts economic opportunities and vitality as well as livability of the communities along its path. SCDOT has offered a number of opportunities to engage the community in the study including a project web page, a project newsletter, a stakeholder group, a steering committee, media outlets, surveys and public information meetings as well as a number of other meetings with groups interested in transportation planning. The public, industry, local government, transportation providers, and interest groups have been partners in this study. The suggestions, ideas, and guidance received from these I-85 Partners have been invaluable.

6.1 STEERING COMMITTEE AND STAKEHOLDER GROUP

The Planning and Environmental Office of the SCDOT provided management and oversight of the corridor study. A steering committee including transportation engineers and planners from SCDOT, FHWA, GPATS MPO, SPATS, APCOG, GreenLink (transit), and GSP provided guidance for the study. The steering committee met on May 6, 2010; November 18, 2010; and February 25, 2011.

A stakeholder group was established to provide input as the study advanced and included representatives of four municipalities, two county governments, chamber of commerce, airport, six major industries, metropolitan planning organizations, council of governments, and SCDOT. Individually the members of the stakeholders group included elected representatives (mayors, state and local elected officials), industry representatives, and citizens with interest in transportation and commerce. A complete listing of the members of the steering committee and the stakeholder group is included in the Executive Summary. The Stakeholder group met immediately following the Steering Committee on the three dates noted above.

The stakeholder group was intentionally expanded to reach beyond transportation planners and providers. Local governments and local industry were included in the stakeholder group based on their direct interest in the effects of I-85 on the future vitality of the Greenville-Spartanburg region. Local governments are certainly interested in continuing economic growth for it is this economic vitality that provides improved employment opportunities, better medical facilities, expanded educational opportunities, and numerous recreational opportunities; all of which improve the livability of the community. Industry along the I-85 corridor is the driving force behind economic vitality of the region. The employment opportunities, community participation, and improved tax base created by industry is possible as long as industry continues to be successful. Much of the commercial success along

I-85 depends heavily on the ability to move materials, products, and people efficiently along the I-85 corridor. It is for this reason that industries such as Michelin, BMW, Blue Ridge Electric Cooperative, General Electric, the Campbell Center, and the Clemson University International Center of Automotive Research were engaged in the study of the I-85 corridor.

6.2 PUBLIC INFORMATION MEETINGS

Two public information meetings were held during the course of this study. The first meeting was held on Thursday, July 29, 2010 at the Michelin North America Plant located at One Parkway South, Greenville, SC 29615 between 5:00 PM and 7:00 PM. The meeting was an open-house, drop-in format to allow the public an opportunity to view the displays and discuss the corridor study on an individual basis with representatives of SCDOT. Approximately fifty people attended the meeting. The meeting was also well covered by local print and broadcast media. A brief presentation on the corridor study was made in the Auditorium at 5:30 PM. The presentation discussed the purpose of the study and the study process. The public was invited to submit ideas at the meeting on comment forms or to comment later via the project web page or email. Representatives of SCDOT and the study team were available to discuss the Corridor Study with members of the public on an individual basis.

The second public information meeting was held between 5:00 PM and 7:00 PM on April 28, 2011 at the Michelin North America Plant. The meeting was an open-house, drop-in format with a presentation of recommendations for corridor improvements given in the Auditorium at 6:00 PM. Information packets were provided to local media present at the meeting. The presentation included a brief overview of the study, a more detailed listing of the improvements that are recommended, and a brief discussion of the next steps in the process of improving the I-85 corridor. The public was invited to provide comments on the study recommendations. Representatives of SCDOT and the study team were available to discuss the Corridor Study with members of the public on an individual basis.

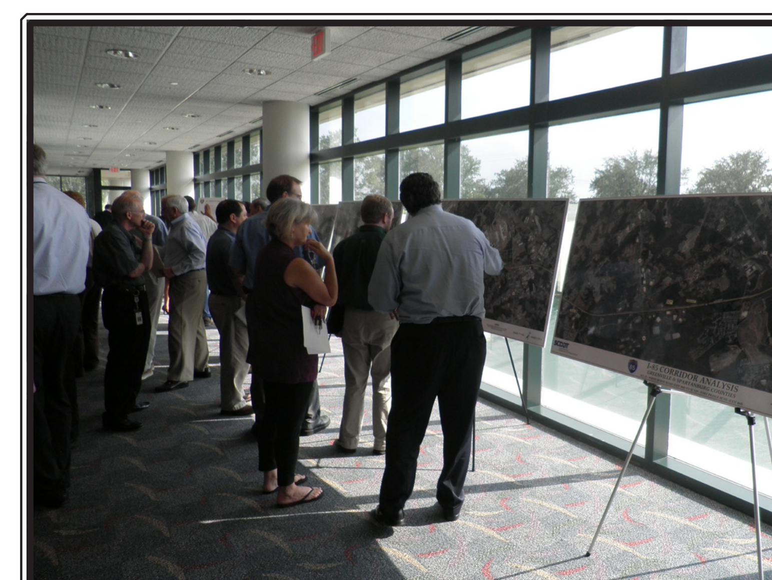
6.3 PUBLIC COMMENTS

Comments from the public have been received through two primary means: email directly through the project web page and written comments received as a direct response to the public information meetings. Additionally, the Greenville News provided copies of the comments received on their web page following the public information meetings. Handouts at public information meetings, newsletters, and the SCDOT project web page all invited the public to provide comments and included contact information.

SCDOT received more than 150 comments from the public following the July 2010 public information meeting. Many comments contained several ideas for improvement. Each idea was listed separately and a count of repeated ideas kept as an indicator of importance to the public. Each idea was reviewed and many of the ideas offered by the public have been included in the improvement strategies considered in this study. Exhibit 44 provides a summary of the more frequent comments. A listing of each idea along with the disposition of the idea is included in Appendix A.

Exhibit 44: Summary of July 2010 Public Information Meeting Comments

Number of Comments Received	General Comment Description
30	Connect ramp lanes on northbound I-85 between I-385 and Pelham Road
20	Make I-85 southbound four lanes between Pelham Road and I-385
16	Improve signs and lighting to assist traffic in determining correct lanes
14	Restrict truck traffic to specific lanes or by time of day
21	Miscellaneous geometric improvements
6	Increase use of transit such as buses, high speed rail, and monorail



Public Information Meeting July 29, 2010

Following the public information meeting in April 2011, nine comments were received. The ideas expressed in these comments were also listed and tallied. All the comments were reviewed and considered in the final evaluation of the improvement strategies. Exhibit 45 provides a listing of the comments received after the second public information meeting. All ideas for improvement are included in Appendix A.

Exhibit 45: Summary of April 2011 Public Information Meeting Comments

Number of Comments Received	General Comment Description
1	Construct an interstate connector between current southern terminus of Southern Connector and SC 290 or SC 101
1	Improve interchange at Laurens Road
1	Provide alternative route from Mauldin Road to Laurens Road
1	Make I-85 southbound and northbound 4 lanes
1	Safety concerns about use of guardrails
1	Focus on US 29 as a parallel route
1	Increase metro transit - HOV Lanes, light rail, trolleys
1	Increased passenger rail service
1	Do not widen I-85 to eight-lanes as this would increase toxic air emissions

6.4 SPECIAL FOCUS MEETINGS

The SCDOT study manager and the consultant project manager met with several entities that have a particular interest in the I-85 corridor. These entities included SPATS in June 2010, Greenlink in October 2010, SPARTA (Spartanburg Area Regional Transit Agency) in October 2010, GSP in November 2010, and a combined meeting with Upstate Forever and the Southern Environmental Law Center in November 2010. A second meeting was held with Upstate Forever in April 2011. The purpose of the meetings was to provide updated information on the corridor study and to receive any input or suggestions offered.

6.5 INDUSTRY OUTREACH

Freight Survey

In a further effort to engage industry located along the corridor and moving freight through the corridor, over 100 surveys were sent to industry located in the corridor and to freight companies shipping through the corridor. The South Carolina Trucking Association assisted in identifying freight haulers and logistic providers. Included with the survey was a cover letter to explain the objectives of the corridor study and the desire for industry input. Approximately 20 percent of the surveys were returned. All of the respondents stated that the most serious problem along the I-85 corridor is traffic congestion. The majority of the surveys indicated that the Pelham Rd. (Exit #54), Woodruff Rd. (Exit #51), and I-385 interchanges are the exits that are the most congested and present the most problems during both the morning and afternoon rush hours, Monday through Friday.

The responses from industry also included a number of suggestions for improvements. The main suggestions are shown in the table below.

Exhibit 46: Industry Suggested Improvements

Improvement Description	% Making Recommendation
Improve Signage	56%
Need a parallel route to I-85	50%
Need additional lanes in each direction	44%
Need additional truck parking	39%
Improve ramps	28%

While the companies responding to the survey noted deficiencies along the corridor and suggested improvements, the industries using the corridor are also actively engaged in mitigating the impact of congestion on their operations. Exhibit 47 includes a variety of actions that many of the responding companies employ to improve their shipping logistics.

Exhibit 47: Industry Congestion Mitigation Strategies

Limit number of trucks dispatched at rush hour times
Dispatch traffic congestion information to drivers to avoid area
Avoid allowing any freight sent out during rush hour
Allow additional travel times for delays
Use secondary and alternate primary roads to circumvent congestion
Alert drivers of accidents in areas

Employer Survey

Thirty companies located along this section of the I-85 Corridor were sent Employer Survey Questionnaires. The companies included major employers as well as smaller firms. Thirteen companies completed the Survey. One of the main topics of the survey was employee and employer participation in various forms of ridesharing such as carpooling and vanpooling. Only one of the companies surveyed reported that they offered their employees a rideshare program, which mainly consisted of carpooling. Another company reported that some of its employees do carpool to and from work, but there is not a formal rideshare program in existence.

Additional Industry Contact

In addition to the surveys noted above, several industries or associations were contacted directly for input. These included Norfolk Southern, the South Carolina Trucking Association, Bulldog Trucking, Michelin North America, BMW, the Greenville County Chamber of Commerce, Greenlink, SPARTA, and the Greenville-Spartanburg Airport.

6.6 OTHER OUTREACH EFFORTS

A project newsletter was published on November 29, 2010 and on April 20, 2011. The four-page full color newsletter was sent as an update to everyone who had provided a comment, sent an email, or attended the first public information meeting. In addition, the newsletter was provided to the steering committee and the stakeholder group. The newsletter provided background and an update on the study. The second edition of the newsletter was distributed in April 2011 as an update and an announcement of the upcoming public information meeting.

The project web page (www.SCDOT.org/inside/I-85) has proven to be a popular tool for the public to contact SCDOT regarding the project. The project web page is actually several pages that include a description of the study corridor, the process and schedule to be followed, and the purpose and anticipated outcome of the study. Additionally, the project web page included project contact information and an email portal that provided messages directly to the SCDOT study manager. Comments received by the study manager were forwarded to the project team for consideration in the ongoing study.

6.7 CONCEPTUAL STRATEGIES WORKSHOP

SCDOT conducted a two-day workshop on September 15-16, 2010. The purpose of the workshop was to evaluate all ideas for improvements in traffic along the I-85 corridor that were received as of the date of the workshop and to determine which ideas had potential to improve the I-85 corridor and should be given further consideration. The ideas came from several sources: public comments, study team members, and workshop participants. Sixty-two ideas from the public representing over 156 comments were provided to the workshop participants for review and consideration. A list of all ideas received from the public was provided to each workshop participant and discussed at the workshop.

The thirty-two workshop participants included engineers from Greenville County, Spartanburg County, City of Greenville, SCDOT, FHWA, and the engineering firms conducting the study for SCDOT. Planners from GPATS and SPATS also participated in the workshop. Information reviewed at the workshop included traffic volumes for the years 2010 and 2035, level of service, accident data, VISSIM traffic model results, and existing plans. The workshop participants discussed transit and bus options, ideas to reduce travel demand, high occupancy vehicle (HOV) lanes, high occupancy toll (HOT) lanes, and identified over 28 concepts for improvements along the I-85 corridor. The strategies developed at the workshop have been further evaluated to determine the potential for improvement. These strategies are discussed in more detail in subsequent sections of this report.

Chapter 7: Travel Demand Management

Travel demand is the collective desire by a wide array of motorists to drive on a highway. High travel demand in concentrated time periods such as during the morning commute results in a "rush hour" (peak hours). When the demand is close to or exceeds the capacity of the roadway, congestion results. Travel demand management (TDM) is a deliberate attempt to influence the number of vehicles attempting to use the highway at a particular time. This chapter explores a number of strategies that have the potential to decrease travel demand and thereby decrease congestion, particularly in the peak hours. Each strategy is identified with the label "TDM" followed by a number in order to track these strategies throughout this report.

7.1 TRAVEL INFORMATION SERVICES (TDM1 AND TDM2)

Dynamic Message Signs (TDM1)

Roadway information can be provided through on road signing, advising motorist of special conditions in the immediate vicinity or well in advance of an actual event. This information is displayed using Variable Message Signs (VMS) or Dynamic Message Signs (DMS). VMS signs are portable, shoulder mounted signs and DMS signs are permanent, structures mounted over the roadway. Generally VMS signs warn of special conditions such as lane closures due to construction or other incidents.

DMS signs may be used for incidents, but also may be used to convey travel times to significant interchanges along the route. The travel times displayed take into account the actual prevailing speed of traffic and are adjusted to account for congestion along the route. The signs may also be used to provide information such as Amber Alerts to advise of child abductions in the area.

In the study area there are currently five VMS signs and three DMS signs. Additional DMS signs would be beneficial to the public and to incident responders advising of incidents ahead that require lane closures or detours.

It is recommended that five new DMS signs be considered at the following locations in order of priority:

- I-85 NB between I-385 and Pelham Road (locate approximately 4,000 feet north of the Roper Mountain Road)
- I-85 SB between Woodruff Road and Laurens Road (locate approximately 1,000 feet south of the Salters Road)

- I-85 NB between SC 101 and SC 290 (locate approximately 1,000 feet north of the Dantzler Road overpass)
- I-85 SB between SC 290 and SC 101 (erect on the same structure as the sign described above)
- I-85 NB south of US 25 (locate approximately 1,000 feet south of SC 20)

SCDOT Website Enhancement (TDM2)

SCDOT currently has a variety of ways to communicate travel conditions throughout the state. Through its website at www.scdot.org motorists can access SCDOT's traffic cameras, get updates on construction activities, road conditions, evacuation routes and weather conditions. It is recommended that information on existing Park & Ride facilities, transit opportunities, and Rideshare programs be added to the SCDOT website. This information should be updated as new facilities and opportunities are implemented.

7.2 511 SERVICE (TDM3)

SCDOT has deployed a new travel information service, 511, which will provide motorists a source of up to date travel conditions by route for all Interstate routes in the state. This information can be accessed by dialing 511. This information can also be accessed by computer before beginning a trip. Email alerts can also be provided to subscribers of the service. There is no charge for the service other than the subscribed personal cell phone service. It is recommended that SCDOT continue to improve the customer friendliness of the system and refer users to the SCDOT website for additional information.

7.3 OUTREACH AND EDUCATION (TDM4)

As mentioned in Chapter 6, an important component of this study has been public and community involvement. In addition to the public and community outreach efforts, major employers and traffic generators were specifically targeted through surveys and interviews.

Major Employers

One important aspect of the outreach process was identification and involvement of the major employers in the study area. Some of these were included in the stakeholder group and one was on both the stakeholder group and the steering committee. Input from these major employers was especially important in research on the rideshare programs as well as freight handling.
Major employers in the area include:

- Hubbell Lighting
- BMW Manufacturing
- Greenville-Spartanburg Airport
- Michelin North America
- Furman University
- Greenville Technical College
- Lockheed Martin Aircraft & Logistics
- Clemson University International Center for Automotive Research
- Blue Ridge Electric Cooperative
- Fluor Corporation
- Sealed Air Corp – Cryovac Division
- General Electric
- C&S Wholesale – Bi-Lo Grocery Distribution
- Campbell Center
- Jacobs Engineering Group

Major Traffic Generators

Traffic congestion along the corridor is continually worsening with delays becoming more numerous and peak rush hours getting longer. Exhibit 48 lists the number of employees for some of the major employers previously listed. None of these companies have formal rideshare or carpooling programs, although several expressed interest in possibly implementing such programs. One company had a formal program for several years but was unable to continue with it due to logistical problems with employees on overtime.

Exhibit 48: Number Employed by Major Employers within Study Area

Company	Number of Employees	I-85 Corridor Exit No.
Hubbell Lighting	480	51
BMW Manufacturing	7000	58 & 60
Greenville-Spartanburg Airport	650	56 & 57
Michelin North America	4000	54
Jacobs Engineering Group	600	51
Furman University	3300	48
Greenville Technical College	1500	46

A program to engage the major employers and traffic generators along the corridor should be established. With the lack of formal rideshare or carpooling programs, there is a great opportunity to reach out to these employers and their employees to make them aware of the opportunities that exist for sharing rides. Outreach efforts should include discussions with management to determine their level of interest and support, and the best way to share information with the employees.

This outreach and education effort has potential benefits for both employer and employee in the form of reduced congestion on I-85 and local routes, improved on-time arrival of employees, and reduced travel cost to employees. A partnership of transportation planners and providers working in cooperation with major employers should educate the employees on options other than driving alone. These options include transit, park and ride lots, carpooling, or developing ridesharing programs. Based on the opportunities that exist today, this outreach effort has the potential to reduce peak hour traffic by 1%. As incentives such as increased fuel prices and employers' encouragement increase, the potential for employees to share rides will be increased and the impacts on traffic could increase well beyond the 1%.

7.4 FREIGHT TRIP PLANNING (TDM5)

Another major contributor to traffic in the corridor is freight movement, both through the corridor and locally, especially to the manufacturing plants listed in Exhibit 48. Truck traffic makes up approximately 28% of the traffic volumes in the corridor study area; however, it is difficult to determine what percentage is passing through as compared to delivering in the area.

As previously stated in Chapter 6, a freight survey was conducted in order to determine the potential to reduce and/or reschedule freight trips during peak traffic hours as well as gather information and identify locations along the corridor where improvements are needed to facilitate freight movements. A list of freight moving companies in the area was compiled using information from the South Carolina Trucking Association and the major employers in the area. A survey questionnaire was developed and over 100 surveys were sent to the identified companies. In addition to the surveys noted above, several industries or associations were contacted directly for input. These included Norfolk Southern, the South Carolina Trucking Association, Bulldog Trucking, Michelin North America, BMW, the Greenville County Chamber of Commerce, Greenlink, SPARTA, and the Greenville-Spartanburg Airport.

All of the respondents stated that the most serious problem along the I-85 corridor is highway congestion. Close to half of the freight moved through the corridor during peak traffic hours (24% from 6:00 AM to 9:00 AM and 26% from 3:00 PM to 6:00 PM). Freight carriers realize the problems of moving freight through the area during peak traffic hours, but the timing of moving freight is largely client driven. Therefore, delivery obligations may necessitate driving during rush hours. Some methods of freight trip planning that companies currently use to avoid corridor congestion are limiting the number of trucks dispatched at rush hours, using secondary and other primary roads to avoid congestion on I-85, and using dispatch information for truckers to avoid congestion areas and accident areas. Additional freight trip planning encouragement from transportation planning agencies is unlikely to result in significant reductions in truck traffic during peak hours.

Recommended improvements garnered from the surveys include:

- Additional lanes in each direction
- Additional truck parking in order to wait out peak hours when delivery schedules allow
- A parallel route to I-85
- Improved designs such as longer entrance and exit ramps, wider lane widths, and improved signage

All of the above survey recommendations are discussed and evaluated in more detail in other sections of this report.

7.5 TRANSIT ORIENTED DEVELOPMENT (TDM6)

Transit oriented development (TOD) is defined as compact, mixed-use development within easy walking distance of public transportation and is a key element of livable, sustainable communities. TOD is about creating communities where people have transportation and housing choices, where people can walk, ride a bike, and take public transit on a daily basis. Creating a convenient and affordable lifestyle where housing, employment, entertainment, and restaurants are conveniently located and easily reached by modes of travel other than private automobiles.

Land use and development planning activities are primarily the responsibility and purview of local governments. Local governments have the best opportunity to directly promote TOD through zoning and land use planning regulations. State, regional, and local government agencies responsible for transportation planning can encourage TOD through their associations and partnerships with local and regional planning commissions and agencies. Encouraging and supporting activities may include a review of policies related to transit, bikes, and pedestrians to assure that these are considered in project development. Most transportation agencies have over the past decade included consideration of bicycle and pedestrian accommodations in planning and developing projects. Transportation project prioritization and planning could also include a consideration of the potential for future transit service and TOD development. Establishing partnerships between agencies involved in highway planning, transit planning, and land use planning is essential to successful TOD implementation. State and regional governments can take a lead in forming new partnerships in support of TOD.

The potential benefits of TOD include increased transit ridership, reduced travel demand on highways and streets, reduced outlays for roads, improved air quality, and improved safety for pedestrians and cyclist. Additionally, increased transit and non-motorized transportation opportunities associated with TOD can improve mobility for those with limited or no access to an automobile. These benefits may not be immediate, but accrue over time as policies and zoning that encourage TOD are implemented.

While the Federal Transit Administration (FTA) does not provide grants for TOD development, FTA funding can be used for projects that support TOD. Some of these related activities include right of way acquisition, site preparation, walkways, intermodal transfer facilities, parking, pedestrian improvements, and bicycle improvements.

7.6 INTEGRATED CORRIDOR MANAGEMENT (TDM7)

Americans lost 4.2 billion hours of time and used an extra 2.8 billion gallons of fuel in 2007 due to congestion on the nation's highways[3]. In 2006 the US Department of Transportation (USDOT) launched an initiative to implement the Integrated Corridor Management concept on several demonstration projects. Integrated Corridor Management (ICM) considers all modes of transportation of people and goods within a corridor into a cohesive plan. The goal of the ICM initiative is to demonstrate the benefits of a holistic approach that considers all modes of transportation. An ICM plan would include all transportation providers in the development of a multimodal plan. The main objective is to optimize the use of available infrastructure by directing travelers to under utilized travel capacity within the corridor. The strategies could include changes in travel departure time, changing routes, using HOV lanes, or using other modes of transportation.

Demonstration projects have been selected for implementation on eight of the nation's busiest corridors. The method used for the USDOT demonstration projects include establishing a stakeholder working group, conducting traffic and travel analysis, developing the corridor model and strategies for integration, implementation of improvement strategies, and evaluation of results. The benefits of ICM are:

- Establishes platform for cooperative effort between providers of various modes of transportation
- Improves ability to optimize the use and future growth of existing infrastructure,
- Provides the public and operating agencies with comparative travel information for various modes and routes,
- Provides continuous improvement of implementation plans, and
- Improves travel time reliability.

This I-85 Corridor Study provides an excellent starting point to begin the discussion of integrating the various modes of transportation that serve within and along the I-85 corridor. Establishing an I-85 Corridor Focus Group is recommended as a first step in moving toward an integrated and holistic approach to moving people and goods through the corridor. The Focus Group should include state, regional, and local government transportation planners, transportation agencies, transportation providers representing various modes, and transportation users. The Corridor Focus Group would establish a vision for the corridor and establish a platform for communication and cooperation.

7.7 TOLLS

Tolls are a direct fee charged specifically for the use of a highway or bridge. Historically, tolls have been used primarily as a funding mechanism for the construction of highways and bridges. The success of tolling depended upon the traffic demand for the facility. In more recent years, tolling has been increasingly viewed as a means to improve transportation system performance through reduced congestion, improved reliability, and improved quality of life for residents. Reduced congestion may be achieved with tolls through the concept of congestion pricing. The concept of tolling and congestion pricing is based on charging for access and use of the highway.

Legal Authority for Tolling

The imposition of tolls on an existing interstate highway requires legal authority from the Federal government. Federal laws that apply to tolling are briefly described below:

- Title 23 U.S.C. 301 generally prohibits tolls on facilities constructed with federal funds which include most existing interstate highways. The Safe, Accountable, Flexible, Efficient Transportation

3 Integrated Corridor Management; Public Roads, November/December 2010

Equity Act: A Legacy for Users (SAFETEA-LU) does allow exceptions:

- ◇ SAFETEA-LU permits the conversion of High Occupancy Vehicle (HOV) lanes to High Occupancy Toll (HOT) lanes or the addition of lanes as HOT lanes. There is no limit on the number of projects.
- ◇ The Express Lanes Demonstration program allows tolling of lanes to manage congestion, and reduce vehicle emissions, and finance additional interstate lanes for the purpose of reducing congestion. The use of congestion pricing is required. This program is limited to fifteen projects nationwide.
- ◇ The Interstate System Construction Toll Pilot program allows tolling for the financing of new interstate highways and is limited to three projects nationwide. This program is not applicable to existing interstate highways.
- ◇ The Value Pricing Pilot program encourages implementation and evaluation of value pricing pilot projects to manage congestion on highways through tolling and other pricing mechanisms. The program is limited to 15 slots of which only one vacancy remains.

- The Interstate System Reconstruction and Rehabilitation Pilot program established by the Transportation Efficiency Act for the Twenty-first Century (TEA-21) allows improvements to existing interstate highways to be funded through tolling. This program was limited to three projects; one slot remains available.
- Title 23 U.S.C. 129 permits the use of tolls on free interstates to fund for bridges and tunnels.

Regarding South Carolina law, legislation (Senate Bill S.103) is currently pending action in the 119th Session of the General Assembly (2011-2012) to amend Chapter 3, Title 57 of the 1976 Code to require approval of the General Assembly prior to tolling an existing interstate highway.

Tolling Opportunities

Opportunities exist to toll I-85 through the addition of HOT lanes, the Express Lanes Demonstration program, the Value Pricing Pilot program, and the Interstate System Reconstruction and Rehabilitation Pilot program. Each of these programs will require the construction of additional lanes and/or other improvements to be eligible for implementation of tolls. The Interstate Reconstruction and Rehabilitation Pilot program is the only program which does not require congestion pricing. However, congestion pricing could be included as part of a tolling plan. Extension of the program limits for the above programs or additional opportunities outside of these programs could be achieved by congressional action.

Reconstruction and Rehabilitation

A toll for the improvement of I-85 would include constructing an additional through lane in each direction as well as upgrades to ramps, interchanges, signing, IT equipment and other miscellaneous improvements. The toll could be imposed as a uniform flat rate without regard to the levels of congestion along the highway or the toll could be based on congestion pricing. A flat rate toll can be expected to divert traffic to other routes for short local trips. However, there are few roads that can serve as alternate routes for trips of more than a few miles.

The benefits of a toll in reducing travel demand are anticipated to be minimal. A recent study prepared by the consulting firm HNTB for the Maine Turnpike Authority studied the diversion of traffic to a parallel route (US 202) along a 12-mile stretch of the Maine Turnpike between the towns of Auburn and Gray. The parallel route is also approximately 12 miles in length and has an average separation distance of approximately three-fourths of a mile. The diversion rate was determined to be approximately 3.0%[4]. Due to the lack of a nearby parallel route, the diversion rate for traffic on I-85 seeking to avoid the toll is anticipated to by less than 1%.

Flat Rate Tolling of all traffic on I-85 would have the benefit of providing a significant funding source that would pay for the additional lanes and other improvements. A limited analysis based on an initial toll rate of $0.14 per mile (or $3.50 for the 25-mile corridor) would generate sufficient revenue to repay $300 million borrowed at a rate of 5% in approximately 20 years. More detailed analyses would be required should tolling be considered as a funding source for highway improvements.

Congestion Pricing could also be applied to all traffic on I-85. The toll rates would be variable with higher rates charged during peak travel hours. Variable rates could be "stepped" or "dynamically" set. Stepped rates (see Exhibit 49) are predetermined with higher rates charged during peak hours (see Exhibit 49). Dynamically set rates are adjusted during peak hours based on the real-time observation of congestion. The goal of congestion pricing would be to reduce the travel demand in the peak hours for the morning and afternoon by providing an incentive to travel in non-peak hours. The incentive would be in the form of higher toll rates in the peak travel hours when congestion is worse and lower or discount rates in the non-peak hours. Congestion pricing studies indicate that a 5 to 10% shift in peak traffic volume could be anticipated based on congestion pricing. This shift could be even higher as commuters seek other modes of travel such as transit and rail. Toll revenue generated by congestion pricing may be similar to that described for a flat rate toll as the average toll rate could be similar to the flat rate.

4 New Gloucester Toll Plaza Diversion Study: Main Turnpike and Route 202, Gray to Auburn; prepared by HNTB; May 2007

Exhibit 49: Example of Stepped Toll for Congestion Pricing

Maximum Toll Rates	Evening Period (Northbound)							
$4.00				X	X			
$3.00								
$2.50								
$2.00		X	X			X		
$1.50							X	
$1.00								
$0.75	X							X
$0.50								
	3:00-3:30	3:30-4:00	4:00-4:30	4:30-5:00	5:00-5:30	5:30-6:00	6:00-6:30	6:30-7:00

Maximum toll schedule for I-15 HOT lanes, San Diego, California

Variably Priced Lanes

High Occupancy Toll (HOT) and express lanes are also options for managing travel demand through tolling. HOT lanes and express lanes are discussed in greater detail in Chapter 9 as a managed lane strategy.

Benefits of Tolling

Charging a toll for the use of a highway, particularly a previously free highway, will meet resistance from highway users and other interested parties whose businesses depend on travel. However, tolling does have benefits that should be considered in the decision making process:

- Reduces delays and stress, increases predictability of trip times;
- Enhances business by allowing more deliveries per hour;
- Produces revenue for transportation improvements;
- Encourages the use of transit options; and
- Encourages carpooling and increased vehicle occupancy.

Toll Collection Methods

Improvements in technologies in recent years make toll collection easier and possible at highway speeds. There would be no "manned" toll booths. Tolls would be collected by electronic toll collection (ETC) and video toll collection. ETC systems such as E-Z Pass and Palmetto Pass collect tolls by reading a transponder mounted in the vehicle and automatically charge the drivers account. The video toll collection would complement the ETC system and provide toll collection for drivers without transponders. Video toll collection uses cameras to record vehicle tag numbers and sends invoices directly to the vehicle owner. If tolls were implemented on I-85, it is anticipated that approximately 70% of tolls would be collected by ETC and the remainder collected by video identification.

Truck Tolls

Trucks comprise approximately 12% of traffic in the peak travel hours on I-85. The use of truck only tolls was reviewed as a potential strategy for reducing the number of trucks on the highway in the peak hours. As noted in the previous discussion of Legal Authority for Tolling, tolled express lanes could be created by converting existing lanes or by adding additional lanes to the interstate. The express lanes would have to be restricted to truck usage only with tolls priced based on congestion. Converting an existing lane to a truck express lane would dedicate 33% of the existing highway capacity to trucks, which comprise only 12% of the peak traffic volume. Likewise, adding a lane for trucks only would dedicate 25% of the highway lanes to 12% of the traffic. While large trucks do present challenges to automobile drivers, restricting trucks through a truck only toll is not recommended. If a general toll is implemented along the I-85 corridor, an appropriate toll for trucks could be set to provide an incentive for trucks to travel in non-peak traffic hours.

7.8 ENVIRONMENTAL CONCERNS

Of the four categories of strategies for improving vehicular traffic flow within the study area, Travel Demand Management would have the least disruptive effect on the human and natural environment. This strategy centers on the dissemination of travel and advisory information to assist in the more efficient movement of traffic within the study area. This effort also includes educating the public on ride sharing opportunities, establishing better lines of communication between various providers of inter-modal transportation to increase motorist participation, and efforts to improve freight trip travel times.

Construction activities may include the placement of overhead message signs and possible electronic toll collection devices. All such work would be constructed within the existing right of way. While these strategies offer the possibility of improving travel conditions, none would pose environmental issues that rise to the level of further discussion in this study. Improved travel conditions brought about by travel demand management strategies would benefit the air quality and reduce traffic congestion in the area.

Implementation of the strategies discussed above could be environmentally accomplished by way of Categorical Exclusions to qualify for federal funding. Final determination as to the level of environmental documentation will be made by the FHWA.

7.9 SUMMARY OF TRAVEL DEMAND STRATEGIES

The strategies previously discussed in this chapter are tabulated in Exhibit 50 along with additional details on cost and suggested implementation schedule. Many of the travel demand strategies could be initiated immediately at very low costs. The implementation of theses strategies could produce benefits in the very near future while others may require a longer period to develop to the point of providing benefits to traffic. A number of these strategies are suitable for a collaborative effort between state and local government transportation agencies. While a number of the strategies have relatively small individual potential benefits, many have the potential to grow in their effectiveness over time and taken as a whole, these strategies can have a significant positive effect on the travel along the I-85 corridor. **Reducing travel demand can delay or eliminate the need to widen I-85 along the length of the corridor between Greenville and Spartanburg.** The beneficial impact of TDM strategies on the need for additional lanes on I-85 is evaluated in Chapter 10.

[See Exhibit 50: TDM Summary on next page]

Exhibit 50: TDM Summary

Label	Strategy	Recommendation	Benefit	Timing	Cost (x $1000)	Associated Strategies	Traffic Reduction (%)
TDM1	Travel Information and Advisory Service	Place additional overhead variable message signs over: • NBL between I-385 and Pelham • SBL between Woodruff and Pelham • NBL between SC 101 and SC 290 • SBL between SC 290 and SC 101 • NBL south of US 25	Reduce congestion during incident or heavy traffic Improves safety	2013 2013 2015 2015 2017	175 175 175 175 175		0.2
TDM2	Travel Information and Advisory Service	Add to SCDOT Website: • Information on Park and Ride • Information on Transit Opportunities • Information on Ride Share Programs •	Encourages use of transit Educates public on alternative transportation;	2012	3	M3, M4, M5, M6, M11	0.1
TDM3	511 Service	• Add referral to SCDOT website • Continue to improve customer friendliness •	Reduces congestion Educates motorist on road/traffic conditions Improves safety	2012	1	M5, M6, M11	0.1
TDM4	Public Outreach and Education A. Major Employers B. Major	Partner with major industries to make opportunities known to employees and identify new opportunities to meet employers' and employees' commuting needs	Increases use of Park and Ride, Transit, Ride Sharing Reduces congestion Reduces emissions	2012	20		1.0
TDM5	Freight Trip Planning/Scheduling	Partner with major freight generators and providers to identify and develop opportunities to shift freight traffic to off-peak	Reduces congestion Reduces emissions	2012	10	TDM7	0.2
TDM6	Transit Oriented Development (TOD)	Encourage local planning agencies to consider regulations that favor TOD	Promotes use of transit, bicycling and walking Reduces congestion Reduces emissions	2012	5		0.5
TDM7	Integrated Corridor Management (ICM)	Initiate ICM Focus Group	Establishes cooperative among transportation agencies Improves ability to optimize strategies Improves travel time reliability Provides continuous improvement of plans	2013	15		0.1
				Totals for TDM Strategies	**929**		**2.2**

Chapter 8: Modal Options

Modal options are those strategies that promote directly or support the use of alternate modes of transportation other than single occupant autos and trucks on the highways. Strategies that encourage the use of higher occupancy modes of transportation can reduce the number of vehicles on the highway. These higher occupancy modes of transportation include rail service, transit service, and ridesharing activities. Additionally, bicycling and walking are alternative modes of transportation that could lessen the number of vehicles on the highway. Each modal strategy is identified by "M" followed by a number for tracking throughout this report.

For the I-85 study corridor, the effect of introducing the following modal options was examined:

- Commuter and High Speed Rail Service;
- Express Bus Service;
- Bus Rapid Transit (BRT);
- Ride Sharing Programs;
- Park and Ride Facilities;
- Truck Parking Facilities;
- Transit and Limousine Service to GSP Airport;
- Truck to Train Freight Shifts; and
- Bicycle/Pedestrian Opportunities.

8.1 COMMUTER RAIL (M1) AND HIGHSPEED RAIL SERVICE (M2)

Existing Commuter Rail Service

Greenville and Spartanburg are currently connected by Amtrak service as part of the Crescent Line that connects Washington DC to New Orleans, LA. The Crescent serves the two cities (Greenville and Spartanburg) once a day in each direction, during the overnight hours. The scheduled trip takes 40 minutes to travel between the stations. The southbound train is scheduled to depart Spartanburg at 4:14 AM and arrives in Greenville at 4:54 AM. In the opposite direction, the northbound train is scheduled to depart Greenville at 11:15 PM and reaches Spartanburg at 11:56 PM. The one-way fare for this trip is $12.00. A new service would be required to rectify the relatively inconvenient schedule and trip time. The Greenville station is located downtown near the intersection of West Washington Street and Cook Street. On the other end, the Spartanburg station is located near the intersection of Magnolia Street and East Daniel Morgan Avenue. Both station locations fall outside the I-85 study boundary.

As currently implemented, the Crescent schedule is not attractive to commuters. Therefore, the option of introducing a separate commuter rail service dedicated to passengers in this region should be considered as a modal strategy to shift person trips from highway travel. Ideally, the commuter rail service would use the same existing rail lines used by Amtrak to minimize construction costs and streamline the implementation process. Virginia Railway Express operates on lines owned and maintained by Amtrak, Norfolk Southern and CSX Transportation. According to their Comprehensive Annual Financial Report, year 2010, the operating expenses from June 2009 to June 2010 were $52.59 million with an average cost of approximately $0.58 million per mile.

The Norfolk Southern track between Spartanburg and Greenville currently serves 22 trains per day at operating speeds of up to 79 mph. It is unlikely that the existing tracks could accommodate commuter rail service due to the number of trains that would need to be added and the slower speed of commuter trains. New tracks within the Norfolk Southern right of way or a new right of way dedicated to commuter trains would be needed to implement commuter rail service.

A separate, dedicated commuter rail line between Greenville and Spartanburg will be very costly to construct, and will require substantial right-of-way acquisition in advance of construction. Based on the data obtained from The Georgia Regional Transport Authority, the average construction cost of a new commuter rail line would be approximately $6 million per mile. The initial cost of a new commuter rail line between Greenville and Spartanburg would be approximately $180 million.

A person-trip is a trip by one person in any mode of transportation. Each person is considered as making one person-trip. For example, four persons traveling together in one automobile would make four person-trips.

The person-trip shift is calculated based on the design year (2035) traffic volumes. Assuming a new rail service is implemented with a five-car train with 1,250 seats total. The anticipated average occupancy rate is 60% for new train service and six trips per day are assumed in each direction. This is 4,500 passengers or the equivalent of 3,630 autos in one direction based on an auto occupancy rate of 1.24 passengers per vehicle. Considering that 9% of the traffic is in the peak hour, the number of autos removed from the highway is 327 or approximately 3.4% of the peak hour traffic.

High Speed Rail Service

High Speed Rail typically serves cities separated by longer distance. The two neighboring cities of Greenville and Spartanburg are proposed to be connected as part of the Southeast High Speed Rail Corridor's (SEHSR) Macon-Atlanta-Greenville-Charlotte Corridor. Two stations are proposed at Greenville and Spartanburg. Additionally, another station at GSP is also considered in some of the analysis alternatives. The feasibility study, Evaluation of High Speed Rail Option in the Macon-Atlanta-Greenville-Charlotte Rail Corridor was completed in the August 2008 by Volpe National Transportation System Center, Cambridge, Massachusetts.

Assuming a new rail service is implemented with a four-car train with 1,056 seats total. The anticipated average occupancy rate is 60% and six trips per day are assumed in each direction. This is 3,800 passengers or the equivalent of 3,065 autos in one direction based on an auto occupancy rate of 1.24 passengers per vehicle. Considering that 9% of the traffic is in the peak hour, the number of autos removed from the highway is 276 or approximately 2.8% of the peak hour traffic. If the number of trains per day is less than six in each direction the benefit to traffic would be reduced proportionally.

Funding arrangement through Georgia Department of Transportation (GDOT)

The Georgia Department of Transportation (GDOT), SCDOT, and North Carolina Department of Transportation have signed a memorandum of understanding (MOU) to undertake an analysis of the Macon-Atlanta-Greenville-Charlotte segment under which GDOT will act as the lead state for the work. Federal funds for this purpose will be made available under this agreement to GDOT.

Georgia applied for funding on behalf of all three states. Based on Greenville Spartanburg Business (GSA Business) Journal dated November 10, 2010; the U.S. Department of Transportation has awarded Georgia $4.1 million to conduct the first of two environmental studies needed before developing high-speed rail that would connect Georgia to Charlotte via the Upstate.

Person-Trip Shift Calculation:

The technology options along the proposed Macon-Atlanta-Greenville-Charlotte route considered two types of locomotives; diesel (for 90 mph, 110 mph, 125 mph and 150 mph) and electric (150 mph and 200 mph). In this study the person-trip shift for only the HSR 150 technology was evaluated. The number of train-cars, seats and occupancy rate assumptions were extracted from the SEHRC report.

The following equation calculates the shift of person-trips from the I-85 corridor. The person-trip shift is calculated for the design year (2035) traffic condition.

The success of high speed rail service in reducing traffic on I-85 will depend heavily on the number of stops that are made in the Greenville Spartanburg area. As the proposed service is intended to carry passengers at speeds of 150 to 200 mph, it seems unlikely that two stops will be allowed in a distance of approximately 25 miles. Should only one stop be approved, the benefit of high speed rail services to the I-85 corridor between Greenville and Spartanburg will be greatly diminished. High speed rail service (with stops in both Greenville and Spartanburg) will also compete with any future commuter rail for passengers. For these reasons, the potential traffic reduction from high speed rail was not included separately in the simulation model for modal strategies, but was considered as inclusive in the commuter rail strategy.

8.2 EXPRESS BUS SERVICE (M3)

This mode of transportation involves transporting passengers between the downtown section of the city and the residential suburbs or outer cities. The primary intent of this service is to reduce the single occupancy auto trips along the corridor. The express bus service typically runs faster compared to the regular bus service with minimum stops along the route. The express bus provides service during the peak hour of the day. Currently neither of the two transit authorities in Greenville or Spartanburg offers the express bus service to their residents. Addition of the express bus would have a positive impact on shifting the current trip loads from the I-85 corridor. Greenlink, the transit service in Greenville operated by the Greenville Transit Authority, includes express bus service to and from the GSP in their ten-year plan. This express bus service to GSP would be further supported by the implementation of the proposed park and ride facility at GSP. The potential benefit to traffic on I-85 resulting from express bus service is shown in the following person-trip calculations. A hypothetical example is provided below following the introduction of an express bus service:

Large coach buses with 55 seats departing on ten-minute intervals (10 minute headway) and operating at 70% capacity could carry 231 passengers per hour. This is equivalent to a reduction of 186 autos on I-85 based on an average auto occupancy rate of 1.24 persons per vehicle. Based on the peak hour traffic between Pelham Road and I-385, this is approximately a 1.9% reduction in traffic on I-85. Although SPARTA does not currently include express bus service from Spartanburg to GSP in their transit plan, adding this service in the future could produce similar reductions in traffic on I-85 between GSP and Spartanburg.

Examples of Express Bus Service

There are many express bus services currently operating in many cities within the USA, such as, New York City, Los Angeles, Miami and Seattle. These cities have services on a daily basis and they operate at almost all hours due to the high passenger demand.

8.3 BUS RAPID TRANSIT (BRT) (M4)

Different cities within the USA, such as, New York, Los Angeles, Boston, Seattle, Miami, and Phoenix currently operate BRT transit. The main features of BRT include dedicated running ways, attractive stations and bus stops, distinctive easy-to-board vehicles, off-vehicle fare collection, use of ITS technologies, and frequent all-day service. Ideally, BRT service should operate at least 16 hours each day, with midday headways of 15 minutes or less and peak headways of 10 minutes or less. This service is based on the use of buses, but with the addition of various approaches to provide priority and improved quality of service and image for buses. The buses themselves would have more amenities than standard transit buses. These might include features such as more comfortable seating, on-board Wi-Fi and more stylish interior finishes. BRT also generally includes more developed station areas and other passenger amenities, the use of technology to assist with operations management, and an approach referred to as 'branding' to tie the elements of the service into a marketing package. The intent is to imitate the reliability and attractiveness of rail transit, but at a much lower capital cost.

To initiate the BRT service, a minimum service period of two hours in the morning and two hours in the afternoon is recommended. Headway between buses of 10 minutes is recommended. As ridership grows, the hours of service would be expanded to 16 hours per day.

The I-85 study corridor currently can be accessed through any of the 15 interchange locations within the study limits. As a parallel route with the same general termini as the corridor study; Greenville Highway (US 29) corridor is proposed to have the signal priority to facilitate the BRT service. The traffic signals along US 29 within the study boundary may modified to implement this concept. Additionally a five acre vacant land area may be converted into a Park and Ride (P&R) facility near the I-85 and US 29 Highway interchange. A maximum of 425 cars (@ 85 cars per acre) is estimated to be accommodated at a time. The location of the P&R facility would be adjusted in consultation with the BRT service provider to best accommodate the BRT service. The P&R facility is discussed in further detail in Section 8.5. The proposed BRT service will provide a station at the proposed P&R facility to pick-up and drop-off commuters.

BRT service could be implemented in two phases. The first phase would be from the Greer area to Greenville. Transit service along this segment of US 29 is currently in Greenlink's long range plan. The second phase between Greer and Spartanburg could be implemented later as demand for transit service increases. With the addition of BRT service to Spartanburg, travelers commuting between Spartanburg and Greenville would have an alternative to traveling on I-85.

Planning and Implementation Issues:

Availability of Right of Way – The most significant issue in planning BRT running ways is the availability of right of way, whether on an arterial, adjacent to a highway, or on a separate right-of-way. Dedicating space on existing roadways for either queue jumpers at congested intersections or an entire dedicated lane may require reallocation of roadway space from general travel lanes or parking. Given the potential community impacts, changes to the roadway structure need to be planned carefully.

Enforcement – Managing conflicts with other types of traffic is important to maintain the integrity of any BRT running way. Other vehicles crossing into the path of BRT vehicles or creating congestion in BRT lanes can introduce delays and create safety problems. Enforcing BRT running ways can be done passively through design (e.g., by physical barriers) or active police enforcement. Both types of enforcement require the participation of partners who implement highway design standards and police agencies. Enforcement strategies must also accommodate the operating of vehicles from other transit agencies and from emergency services such as police, ambulance, and fire services.

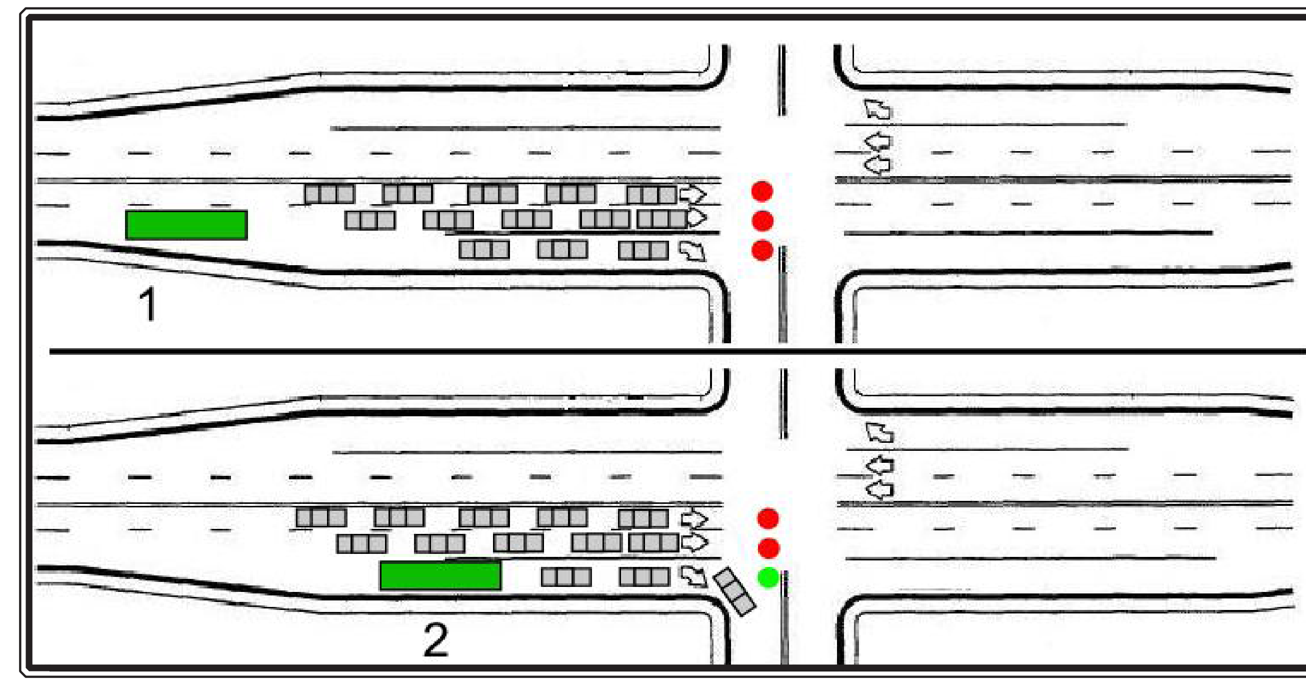
In order to maintain a quicker and precise schedule of the BRT, the following major priority measure, known as Queue Jumpers, would be implemented at the traffic signals along the SC 29 corridor.

Mixed flow lanes with Queue Jumpers:

This measure is recommended only along the SC 29 corridor with signalized intersections, not along I-85 freeway section. In this approach, in order to reduce delay for buses in mixed traffic, queue jump lanes may be provided. Traffic signal priority at the SC 29 intersections, the provision of early greens or extended greens for buses as they approach intersections may be used. The most common form of queue jump lanes are bus-only lanes or combination of bus and right-turn lanes that enable buses to pass through congested intersections with reduced delay. This measure will allow buses to bypass congestion by being given a priority signal allowing them to enter the intersection before any other traffic flow. Implementation of queue jump operations may require both the acquisition of right of way and lane construction where there are no existing right-turn lanes that can be converted. The installations of bus transit signals will also be required. Exhibit 51 shows an example of a queue jump operation with transit signal priority.

A detailed traffic analysis will be required to assess the feasibility of queue jump lanes at the signalized cross street intersections and the specific location and design of this priority measure would be dictated by traffic levels and the configuration of the roadway.

Exhibit 51: Queue Jumper



8.4 RIDE SHARING PROGRAMS (M5)

Traffic congestion along the I-85 Corridor between Greenville and Spartanburg counties is continually getting worse, delays seem to be more numerous, and the rush "hour" is getting longer. Commuters are spending more time in traffic – which means less productive time at their jobs and less valuable time with their families. Recognizing the serious consequences that today's commuting environment has on our economic vitality, productivity, and the quality of life, more and more employers and public agencies nationwide are implementing Rideshare programs to provide commuters with alternative solutions to dealing with the traffic issues they face on a daily basis traveling to and from work.

RIDESHARE PROGRAM

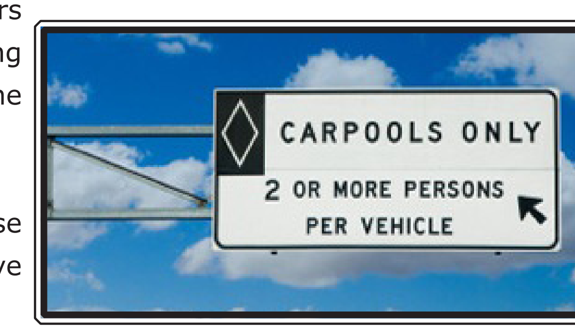
Typical Rideshare programs throughout the United States are free, computer (internet) based commuter matching services provided by either the State DOT, MPOs, municipalities or major employers that are dedicated to finding alternative ways for commuters to travel to and from work. These alternative ways are usually either carpooling or vanpooling. Driving alone is not only expensive, but it also contributes to increased traffic congestion and air pollution. To help commuters cut costs and to reduce traffic congestion and air pollution, Rideshare programs use Geographical Computer Matching to provide travelers with information and assistance about ridesharing and alternatives to the single occupancy vehicle including carpools, vanpools, buses, and trains.

The Greenville-Spartanburg area does not currently have a formal rideshare program, but both cities offer public transportation. Greenlink and the SPARTA are safe, convenient, and economical transportation providers. There are several large companies located along the I-85 Corridor connecting Greenville and Spartanburg counties that currently employ individuals who choose to carpool. Due to the lack of formal rideshare programs in either the Greenville-Spartanburg area or the individual companies, information on the number of carpoolers is not readily available.

COMPONENTS OF RIDESHARE PROGRAMS

CARPOOLING

Carpooling is defined as two or more adult commuters riding together in a private automobile on a continuing basis, regardless of their relationship to each other or the cost of sharing agreements.



Rideshare programs manage a carpool-matching database to help connect people who may work near each other, live in the same neighborhood, and work similar hours.

The results obtained from the Employer Survey Questionnaire that was sent out to companies located along the I-85 Corridor in Greenville and Spartanburg counties, indicated that only one of the companies offered a formal carpooling program. Although most companies do not offer a rideshare program, there are employees who choose to carpool with fellow workers. The survey results did not show a strong utilization of carpooling among the respondents.

Advantages of carpooling:

- Less stress commuting to and from work
- Financial savings due to sharing commuting costs
- Reduced need for parking
- Increased free time for riders
- Less wear & tear on local roads
- Inexpensive alternative to building infrastructure and widening highways
- Reduced pollution due to auto emissions
- Reduced traffic congestion
- Reduced energy consumption

Matching carpool partners

Whether commuters wish to add another person to his/her carpool or simply want to find partners to form a new carpool, rideshare matching programs can assist. Carpool partners are located through a computerized database that matches commuters with similar commutes. There are some innovative ridesharing programs that utilize websites to match riders and even social networking sites such as Facebook can also be useful to bring riders together. Potential carpool matches are also discovered in the workplace or at universities. Individuals seeking others to carpool may use billboards, emails or word of mouth to find riders to share the commute to and from work or school.

Emergency situations or the need to work late and without a car

There are rideshare programs that provide carpool registrants with a determined number of free taxi rides home per year in the event of an emergency or if one of the commuters needs to work unscheduled overtime.

Cost of Rideshare Matching

Typically rideshare matching is a free carpool referral service. The primary cost involved with Rideshare matching programs is administration expenses. These types of programs are usually funded and administered by local or state government agencies.

VANPOOLING

Vanpooling is another way to reduce the number of vehicles on the corridor. A vanpool is typically a group of commuters sharing the ride to work in a commuter van (supplied by employers, non-profit organizations or government agencies). Vanpool programs enable residents to save money and reduce the stress of their daily commute by starting or joining a vanpool. None of the companies surveyed along the I-85 Corridor indicated that their company presently offers vanpooling.

Getting started:

- Commuters need a group of at least five people to start the vanpool.
- All participants should live and work near each other and have similar work hours.
- The vanpool riders determine the exact route to work, the pick-up times, and the drop-off locations. Park and Ride facilities recommended in another section of this report also offer potential pick-up locations.
- One primary driver and at least one alternate driver are required.
- The monthly van lease cost is divided among the riders.

Implementation of Rideshare Programs

The GPATS Long Range Transportation Plan (LRTP) has a list of Travel Demand Management recommendations. The first strategy listed is to "Establish Carpool/ Vanpool Programs". It is unclear how much effort has been expended towards this goal.

Incentives to both employers and employees are critical in successfully implementing a rideshare program. Incentive programs are designed to reward commuters for finding alternative transportation from driving alone. Incentives may include financial rewards for a defined time period for carpooling, vanpooling, or using mass transit. Another financial incentive is the federal tax benefits which allow commuters to set aside money from their paycheck, tax-free, to pay for public transportation, vanpool fare and commuter parking. This money is also free from payroll taxes. Incentives may also include HOV priority lanes and/or preferential parking spaces.

Employers may also offer incentive programs related to their employees work schedules, which may include:

- Flextime – allowing employees to vary their arrival/departure times
- Staggered Work Hours – employer spreads out the employees' arrival/departure time
- Compressed Work Weeks – employees are allowed to work less days by working longer hours on the days they work

Exhibit 52: Major Employers

Company	Number of Employees	I-85 Corridor Exit No.
Hubbell Lighting	480	51
BMW Manufacturing	7000	58 & 60
Greenville- Spartanburg Airport	650	56 & 57
Michelin North America	4000	54
Jacobs Engineering Group	600	51
Furman University	3300	48
Greenville Technical College	1500	46

Based on the number of employees shown in the previous table, if each of these employers implemented a formal ridesharing program, and they had at least 10% of their workforce utilizing the program, the number of vehicles traveling on the I-85 corridor during the morning and afternoon rush hours could be reduced. For example, if 5% of each of the company's employees began carpooling, the number of vehicles utilizing the corridor could be reduced by at least 437 auto-trips per day assuming half of the employees travel on I-85. In 2035 PM peak hour, the southbound I-85 segment between I-385 and Brockman-McClimon Road will carry an average volume of approximately 9,000 vph. The potential auto-trip shift is 218/9,000, or approximately 2%. This is based on a single occupied vehicle trip changed to a double occupied vehicle trip; the numbers of vehicles on the corridor would be reduced further if three or more individuals shared a carpool or if more of employees participate in the rideshare program.

8.5 PARK AND RIDE FACILITIES (M6)

The construction or use of a Park and Ride Lot (P&R) is a simple solution with relatively minor financial investment. The South Carolina Department of Health and Environmental Control (SCDHEC) currently provides three P&R facilities within the state. They are located at US 378 and I-20 in Lexington County, US 378 and SC 261 in Sumter County and US 17A and I-26 in Berkeley County. There are no existing P&R facilities within the I-85 study boundary.

The P&R option will provide incentive to the single auto traveler to switch to public transit or use carpooling, vanpooling, ridesharing or smart-ride. The lots would support future transit operations and would be established at points on the routes to facilitate use of transit service. Most of the major cities within the USA currently offer this P&R option to their residents. The operation study from the existing P&R facilities shows that a well designed and functional P&R facility attracts a large number of commuters and reduces the single occupant auto trips.

This study recommends a minimum of five P&R facilities along the corridor. Each end will have one facility and another two are proposed in the middle of the study area. The fifth P&R facility is proposed near Greer, SC. Two additional P&R facilities are recommended beyond the study corridor limits, one in Anderson County and one near Spartanburg. These five P&R facilities will facilitate and encourage commuters to use higher occupancy means of travel such as carpooling, ridesharing, and public transit.

An estimated value of 85 passenger cars for each acre of the P&R land area is used in the calculation. According to TCRP Report 95 (Park and Ride/Pool study), 2004, the average occupancy rate for Express and Local Bus Park and Ride facilities are approximately 58%. While the average occupancy rate for the Park and Pool facility without the HOV is approximately 50%. Therefore, a conservative value of 50% occupancy of the P&R lots was assumed in performing the calculation.

Each P&R should be well lit and incorporate accommodations for transit, pedestrians, and bicyclists. The accommodations may include bus stops, shelters, sidewalks, and bike racks. The shuttle buses should run between the P&R facility and the nearest transit stop. For the four P&R facilities at interchanges, appropriate signing should be placed on I-85 in advance of the exit identifying the presence of the P&R facility.

Each of the recommended P&R facilities is described in the following section with an estimate of the lot size, autos that can be accommodated, and impact on I-85 traffic. The size of each lot is determined based on property that may be available at the general location. No attempt has been made to determine if a particular parcel is available or if the owner is wiling to sell. Therefore, the aerial photographs accompanying the description of each facility are provided for general location purposes only.

P&R Facilities Within the Study Corridor

P&R Facility near Augusta Road and S. Pleasantburg Drive

This Proposed P&R facility would be constructed on the southern end of the study corridor near the Augusta Road and S. Pleasantburg Drive interchanges with I-85. The approximate size of the proposed P&R facility is 8 acres. A lot this size could accommodate a maximum of 680 cars. Assuming 50% utilization and that users will travel in both directions on I-85, approximately 170 cars may be removed from either direction on I-85 in the peak hours. This is approximately 2.0% of the 2035 PM peak hour traffic on southbound I-85 between Augusta Road and S. Pleasantburg Drive.

A P&R lot at this location will be particularly advantageous as Greenlink Route 10 currently provides bus services on Augusta Road and S. Pleasantburg Drive. The general location is shown in Exhibit 53.

Exhibit 53: P&R Facility 1 - Near Southern End of the Study Area

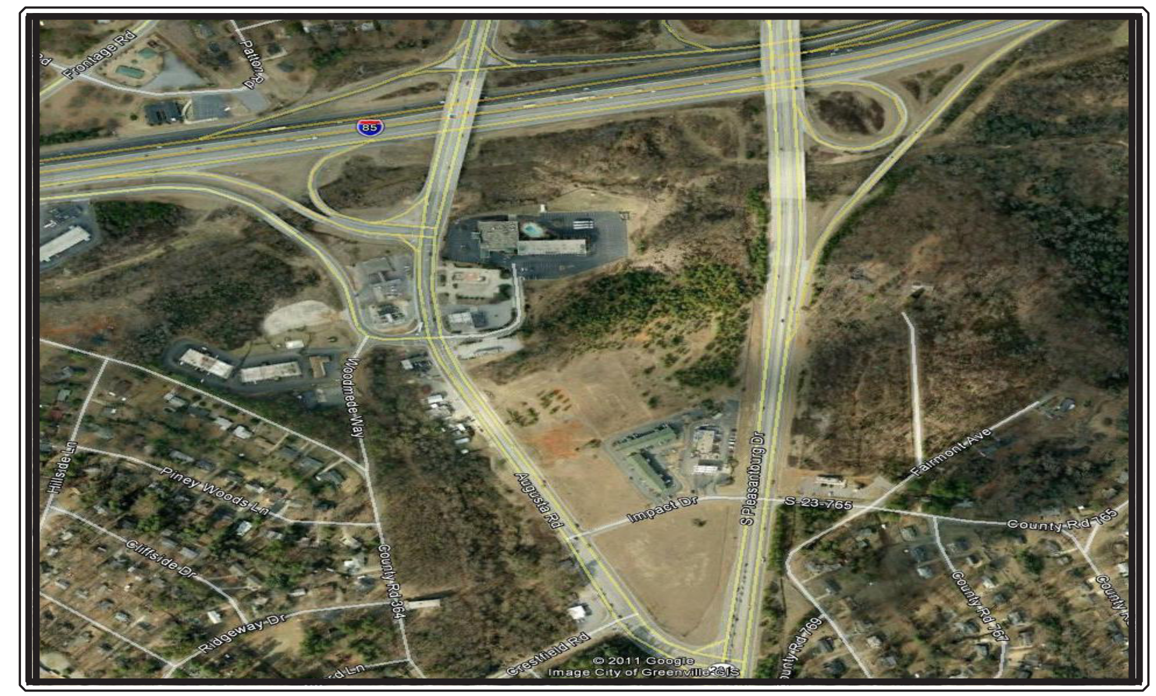
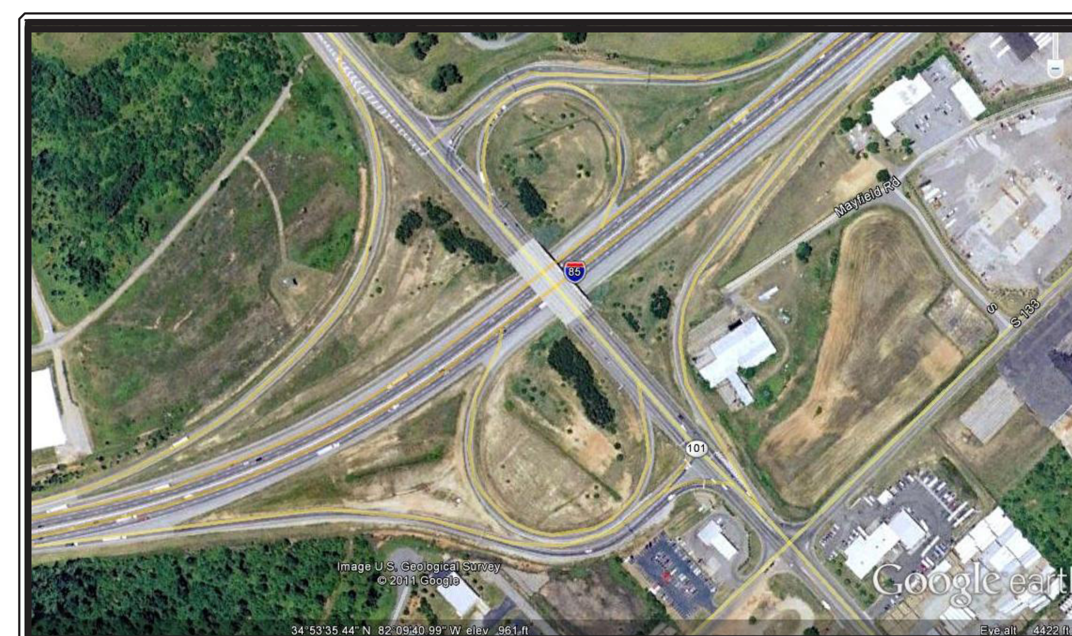


Exhibit 54: P&R Facility 2 - South of the Study Area Center

P&R Facility near the Greenville-Spartanburg Airport (GSP)

Two separate P&R facilities are proposed near the center of the study area. This particular facility would be located near the GSP. The approximate size of the proposed P&R facility is 4 acres. A lot of this size could accommodate a maximum of 340 cars. Assuming 50% utilization and that users will travel in both directions on I-85, approximately 85 cars may be removed from each direction on I-85 in the peak hours. This is approximately 1.1% of the 2035 PM peak hour traffic northbound I-85 between SC 14 and Aviation Drive interchange. The Greenlink Transit Vision and Master Plan proposes a future east-west regional BRT route between downtown Greenville and GPS. This P&R facility will provide opportunity for commuters to use the planned BRT service. The potential site location is shown in the Exhibit 54.

Exhibit 55: P&R Facility 3 - North of the Study Area Center



P&R Facility near SC 101:

This P&R facility is proposed to be constructed near the SC 101 and I-85 interchange. The approximate size of the proposed P&R facility is 3 acres. A lot of this size could accommodate a maximum of 255 cars. Assuming 50% utilization and that users will travel in both directions on I-85, approximately 64 cars may be removed from each direction on I-85 in the peak hours. This is approximately 0.8% of the 2035 PM peak hour traffic on northbound I-85 between SC 101 and SC 290 interchange. The potential site location is shown in Exhibit 55.

Exhibit 56: P&R Facility 4 - Near North End of the Study Area

P&R Facility near US 29

The proposed P&R facility is proposed to be constructed near the US 29 and I-85 interchange. The approximate size of the proposed P&R facility is 5 acres. A lot of this size could accommodate a maximum of 425 cars. Assuming 50% utilization and that users will travel in both directions on I-85, approximately 107 cars may be removed from each direction on I-85 in the peak hours. This is approximately 0.8% of the 2035 PM peak hour traffic on northbound I-85 between US 29 and SC 129 Interchange. The potential site location is shown in Exhibit 56. However, the P&R facility could be located closer to Greer if desirable to accommodate BRT service, as noted in Section 8.3.

Exhibit 57: P&R Facility 5 - In Greer

P&R Facility on US 29 in Greer

The proposed P&R facility is located in Greer. This P&R facility is proposed to be constructed near the US 29 and John Street intersection. The approximate size of the proposed P&R facility is 1 acre. A lot of this size could accommodate a maximum of 85 cars. Assuming 50% utilization and that users will travel in both directions on I-85, approximately 22 cars may be removed from each direction on I-85 in the peak hours. This P&R facility will be primarily accessed through SC 14 corridor. Therefore the I-85 volume near SC 14 interchange was used in this analysis. This is approximately 0.3% of the 2035 PM peak hour traffic on I-85. The Greenlink Transit Vision and Master Plan anticipates establishing the Greer Express bus route between Greer and downtown Greenville. A P&R lot on US 29 in Greer would complement and support the Greer Express service and provide parking for commuters choosing to carpool. The potential site location is shown in Exhibit 57.

Proposed Park & Ride Facilities Beyond the Corridor Study Limits

A number of residents from Anderson and Spartanburg Counties commute to work in the Greenville area. The Greenville County Comprehensive Plan states that 13,766 and 14,586 commute from Anderson and Spartanburg Counties, respectively. While not all of these commuters are travelling on I-85, it can be assumed that many are and that P&R facilities placed along I-85 in these counties would encourage carpooling and have a beneficial effect on I-85 traffic in the peak hours. One P&R facility is proposed beyond the corridor study limits in each county. These proposed facilities are described below.

P&R Facility on US 178 in Anderson County

This proposed P&R facility would be constructed near at the interchange of US 178 (Liberty Highway) and I-85 near Anderson. The assumed size of the proposed P&R facility is about 4 acres. A lot of this size could accommodate a maximum of 340 cars. Assuming 50% utilization and that users will travel in one direction on I-85, approximately 85 cars may be removed from each direction on I-85 in the peak hours. This is approximately 1.0% of the 2035 PM peak hour traffic southbound on I-85 between S. Pleasantburg Drive and Augusta Road. The potential site location is shown in the Exhibit 58.

Proposed P&R near Cleveland Street in Spartanburg

This proposed P&R facility would be constructed near Spartanburg at the Cleveland Street (S-525) interchange with I-85. The assumed approximate size of the proposed P&R facility is about 2.5 acres. A lot of this size could accommodate a maximum of 212 cars. Assuming 50% utilization and that users will travel in one direction on I-85, approximately 53 cars may be removed from one direction on I-85 in the peak hours. This is approximately 0.6% of the 2035 PM peak hour traffic northbound I-85 between US 21 and SC 129. This location also has an advantage of being in close proximity to local bus route, SPARTA Route 5. The potential site location is shown in Exhibit 59.

Summary

The combined cumulative effect of the P&R facilities results in a total reduction in traffic along the I-85 corridor of approximately 7.1%. However, it is reasonable to assume that most of the P&R users are not traveling the full length of the corridor and therefore, each facility has a "zone of influence" that diminishes with distance as drivers reach their destinations along the corridor. In considering this overlap of influence on traffic volumes and recognizing that the benefits of each lot are not directly additive, a conservative estimate of 5.0% reduction in traffic during the peak hour is recommended for evaluation purposes.

Exhibit 58: P&R Facility 6 - South of the Study Area

Exhibit 59: P&R Facility 7 - North of the Study Area

8.6 TRANSIT AND LIMOUSINE SERVICE TO GSP AIRPORT

Limousine Service

Currently there are few limousine services available in the Greenville-Spartanburg study area along with the regular taxi services. The taxi and other limousine agencies provide service to the entire Greenville-Spartanburg metropolitan area. Many of them are located in the vicinity of the Greenville-Spartanburg Airport. The taxi and limousine services will not have any impact on person-trip shift within the study corridor.

Transit Service (M1)

Greenville, SC: Greenlink currently has a total of 11 bus routes operating in the area; Jackson Townhomes (route # 1), White Horse Road via Pendleton (#2), Poinsett (#3), Duncan (#4), Anderson Road (#6), Laurens Road/Haywood Mall (#8), White Horse Road/Berea (#9), Augusta Road (#10), Wade Hampton (#11), Overbrook (#12) and Parker/Woodside (#13). An adult fare for each ride is $1.25 with a transfer fee of $0.50 for each ride. Discounted fare for the seniors, students and children are available. A reduced fare of $22.50 is available for an express pass of 20 ride pass, saving about $2.50 compared to a single adult fare. Greenlink does not operate on Sunday or on national holidays.

Spartanburg, SC: SPARTA operates both regular fixed route buses and Paratransit van services. The Paratransit vans are designed in compliance with the requirements of the Americans with Disabilities Act. These vans can accommodate common wheelchairs up to 30" X 48" measured at 2" above the ground and weighing no more than 600 pounds when occupied. Currently there are eight different bus routes operating in the entire Spartanburg area; Westgate (route # 1), Hillcrest (# 2), North Church (# 3), South Church (# 4), Spartanburg Tech (# 5), South Liberty (# 6), Crest View (# 7) and finally Dorman Center (# 8). An adult fare for each ride is $1.25 with a transfer fee of $0.30 for each ride. Discounted fare for the seniors, students and children are available. A reduced fare of $2.50, $11.25 and $37.50 is available for daily, 10 and 31 day unlimited passes, respectively.

Interaction between Greenlink and SPARTA:

It is important to note that these two transit services do not have any overlapping or common service areas. As a result the demand for the intercity commute between Greenville and Spartanburg area has not developed. Introduction of this intercity service could play a major role in shifting the existing and future person trips from the I-85 corridor. Expansion of one of the existing bus routes of both transit services to a common stop would be a potential solution for serving the two neighboring cities. The Greenlink bus route #8 (Laurens Road/Haywood Mall) provides service to GSP. Again Route #5 (Spartanburg Tech) of SPARTA operates near the I-85 corridor and could be extended to GSP. This extension of service would enable the commuters of these two cities to use each others' transit services. According to the 2010 census results, both Greenville and Spartanburg area will be combined as one single large MPO. Therefore, the consolidation of transit services is desirable.

Additional Transit Service

Transit service to Park and Ride facilities adds a significant opportunity to enhance multi-modal transportation. Of the Park and Ride facilities recommended in Section 8.5 of this study, the P&R lots at SC 101/I-85 and at US 29/I-85 do not have existing or planned transit service. Transit service to these facilities is recommended and should be considered in the design of the P&R facility.

Exhibit 60: SPARTA Route Map

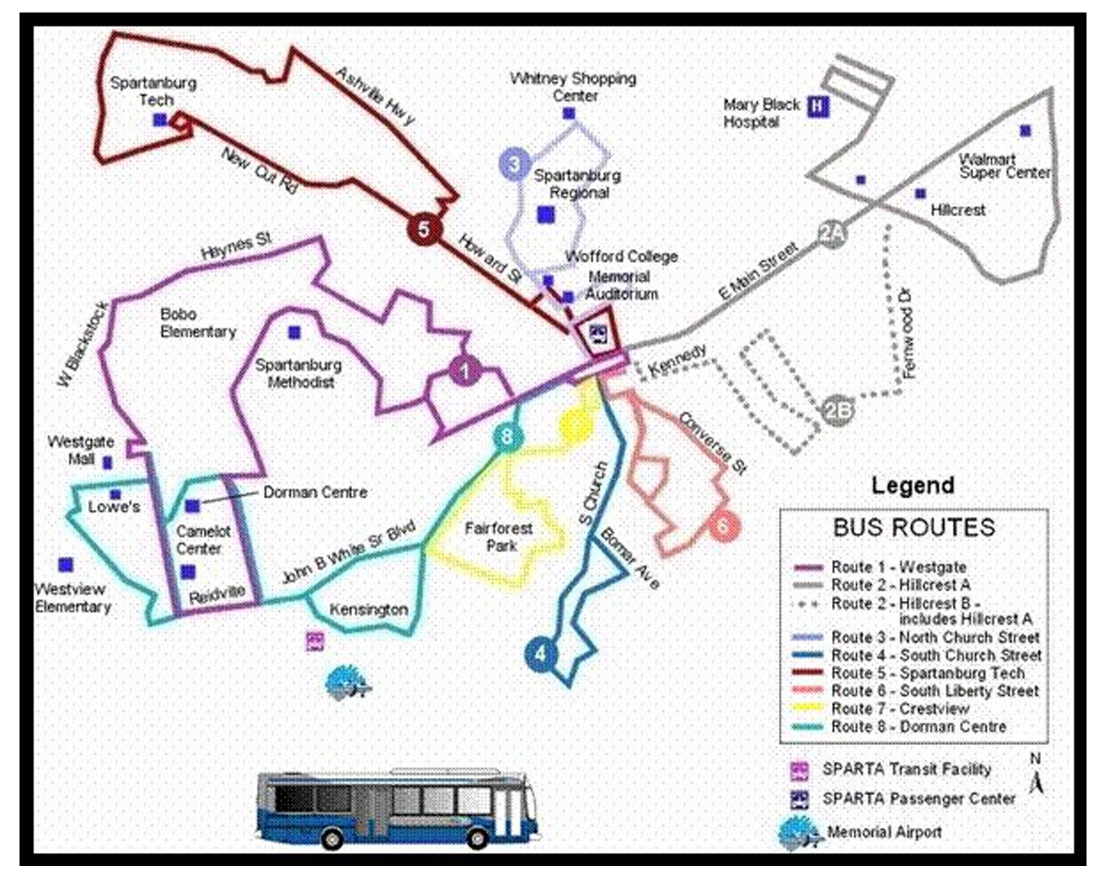
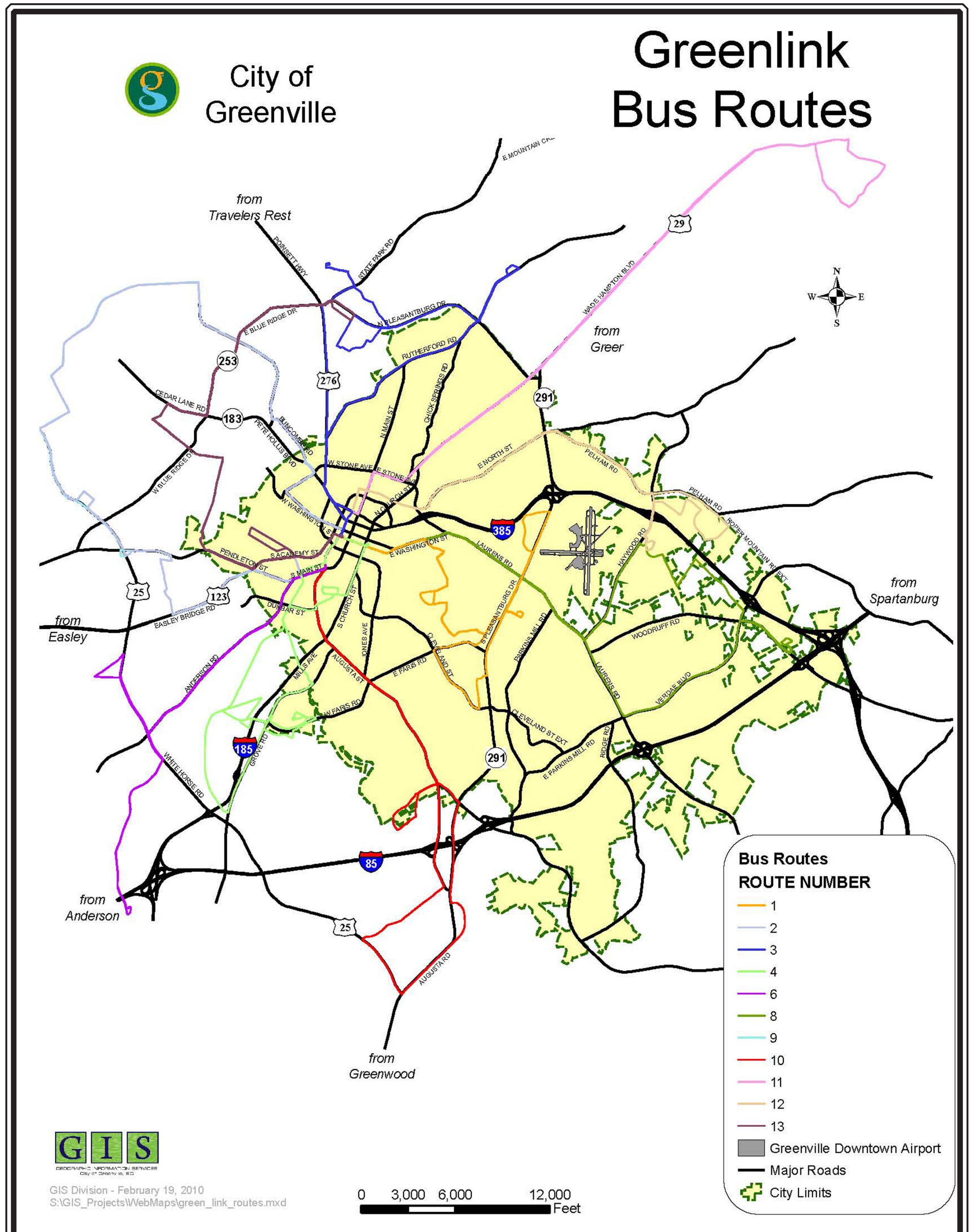


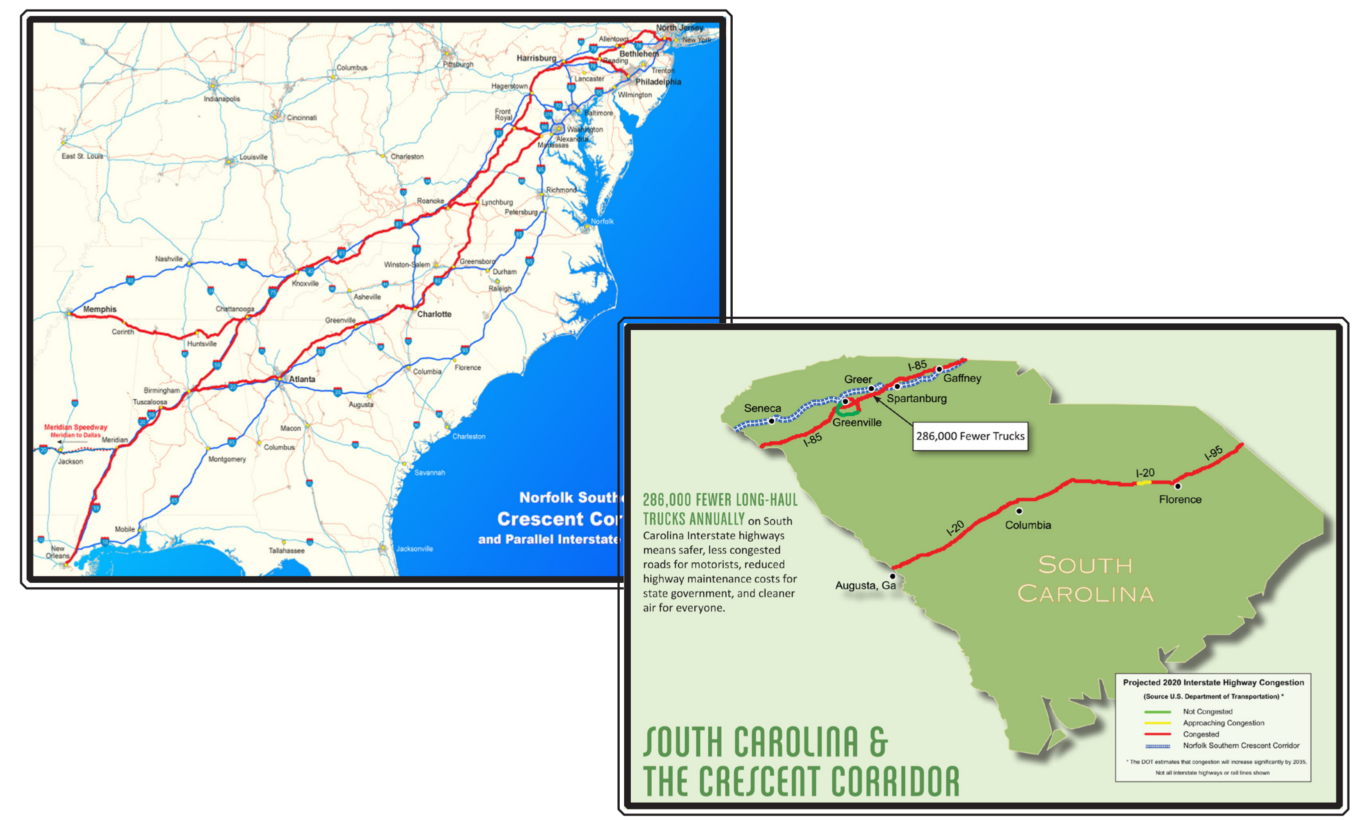
Exhibit 61: Greenlink Route Map



8.7 TRUCK TO TRAIN FREIGHT OPPORTUNITIES (M9)

Based on the data obtained from Norfolk Southern's website (http://www.thefutureneedsus.com/crescent-corridor/) the Crescent Corridor (Exhibit 62) is expected to bring substantial safety, environmental and economic benefits to South Carolina. Each year, the Crescent Corridor will help divert more than 286,000 long-haul trucks from South Carolina highways, including I-85, to the rails. Annually, this should conserve 4.0 million gallons of fuel and reduce CO_2 emissions into the atmosphere by 43,000 tons.

Exhibit 62: Norfolk Southern Crescent Corridor Layout in South Carolina



At the same time, it should save $13.0 million in traffic congestion related costs and $3.4 million from reduced accidents and fatalities and eliminate $2.6 million in annual highway maintenance costs. The Crescent Corridor will provide South Carolina shippers with new high-speed intermodal freight option between the Northeast and Southeast that could reduce their logistic costs by nearly $35.0 million annually.

The potential shift of trucks from the freeway to the railroad is estimated based on the projected annual reduction of 286,000 trucks and 12% trucks in the peak hour. The Crescent Corridor rail service has the potential to remove 70 trucks in each direction from I-85 in the peak hour.

8.8 BICYCLE/PEDESTRIAN OPPORTUNITIES (M8)

Although bicycles and pedestrians are prohibited from the main facility of a freeway by South Carolina law, there are opportunities to serve both these modes in the I-85 corridor. Within the freeway corridor there is the potential for a shared use path. Shared use paths along a freeway may be within the right-of-way but are usually separated from lanes of traffic. For such a facility, structures must be considered. Bike lanes and sidewalks could also be included in the design of any collector distributor roads in the corridor.

The improvements to transit being considered for this corridor allow the opportunity to enhance pedestrian and bicycle access to transit facilities. The development of BRT or other forms of public transportation should incorporate pedestrian and bicycle needs in the planning and implementation. Bicycle parking and bicycle racks on the buses should be included. TCRP Synthesis 62 Integration of Bicycles and Transit available from the Transportation Research Board is an excellent resource for information on this topic.

In addition to the review of I-85, this study includes the review of parallel routes and various interchange improvement projects. Facilities for pedestrians and bicycles should be included within any project corridors and the Complete Streets policies should be adhered to. See Section 9.3 Parallel Route Opportunities.

8.9 TRUCK PARKING AREAS (M10)

Truck traffic is approximately 28% of the total traffic using I-85. During the peak hours trucks are estimated to account for 12% of the total traffic. This change in percentage during the peak hours is mainly due to the increased number of cars commuting to work and school at these times. There may be a slight reduction in the actual number of trucks in the peak hours as major industry along the corridor indicated in the survey and interviews an effort to schedule trucks out of peak hours.

Providing opportunities for trucks to park in convenient and safe areas along the corridor will assist trucks in avoiding peak periods of congestion. Commercial truck stops offer the opportunity for trucks to refuel and drivers to refresh for a price. The only commercial truck stop within the corridor is near the SC 290 interchange. Truck parking areas recommended in this report are not intended to compete with commercial truck stops and would offer no services or conveniences.

Truck Parking Area at White Horse Road

Truck parking areas are recommended at the US 25 (White Horse Road) interchange on the south end of the corridor and south of US 29 on the north end of the corridor. There are several properties in the immediate vicinity of the US 25 interchange that could be converted to truck parking. These sites range from 1.5 acres to 3 acres. Two of these sites (see Exhibit 60) were commercial properties that no longer operate as businesses. The US 25 sites could accommodate 35 to 75 trucks depending on the site selected. A large portion of the expense of these sites would be the cost of property. Property in this area is valued in the range of $90,000 to $125,000 per acre.

Assuming the truck parking area selected will accommodate 75 trucks and will operate at 50% of capacity, this represents an equivalent reduction of approximately 2.5% of the 2035 AM peak hour northbound traffic at this location.

Truck Parking Area South of US 29

On the north end of the corridor, the former rest area currently used as a SCDOT Incident Response staging area (located approximately 1 mile south of US 29) could be converted to a truck parking area if the incident response operations are to moved closer to Greenville. This area will accommodate approximately 15 trucks. The cost of converting this site to truck parking would be limited as the property is currently owned by SCDOT as part of the I-85 right of way.

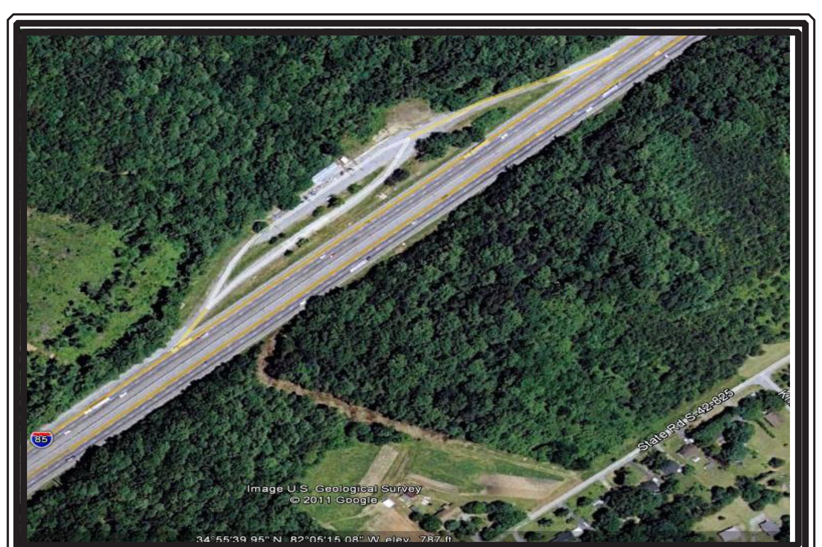
Assuming the truck parking area selected will accommodate 15 trucks and will operate at 50% of capacity, this represents an equivalent reduction of approximately 0.4% of the 2035 AM peak hour southbound traffic at this location.

Summary

The two truck parking areas recommended will on average reduce traffic approximately 1.5%. While the number of trucks that can be accommodated in these lots are a small percentage of the trucks traveling on I-85, this strategy should be developed as a pilot project. Should truck parking areas prove successful, additional lots could be developed in the future.

Exhibit 63: Proposed Truck Parking Areas

US 25 (White Horse Interchange)



SHEP Area South of US 29

8.10 ENVIRONMENTAL CONCERNS

Modal strategies have long been considered as a means to improve the movement of people and goods. While truck and automobile remain the predominant mode of travel preferred by many individuals and businesses, studies continue to support the need for the further integration of rail, bus, vehicle, bicycle, and pedestrian travel to meet demands of area residents and workers.

Under these modal strategies, traffic volumes along the I-85 corridor could be reduced through incorporation of P&R facilities, BRT and express bus service, and commuter rail. These measures should provide some improvement to the area's current travel climate.

The environmental effects of implementing these strategies are expected to be minimal. Five sites for park and ride facilities have been identified in the study and include utilizing existing developed (parking lots) and undeveloped areas for this effort. As such, little environmental consequences would be realized with conversion of these areas to P&R facilities. Construction of these facilities will likely be accomplished by way of Categorical Exclusions. Identification and assessment of specific rail corridors would be necessary before selecting the appropriate environmental documentation needed for federal participation.

Development of bus rapid transit routes such as utilizing US 29 may require roadway improvements such as turn lanes at selected intersections to expedite the movement of bus traffic. These construction activities could be environmentally processed by categorical exclusions although final authority for this action rest with the FHWA.

Consideration of high speed passenger rail will require extensive investment in the current infrastructure with funding likely to be provided through private/public partnerships. This undertaking extends beyond the scope of the document and thus the environmental effects of this option would require more detailed study. It is expected that federal participation in this effort would require an Environmental Impact Statement as a project of this undertaking has the potential for significantly impacting the environment. Currently, the GDOT is preparing a Tier 1 Environmental Impact Statement to extend high speed rail service from North Carolina to Georgia.

Efforts to provide a viable alternative to transporting freight by trucks would be beneficial as trucks constitute approximately 28% of this traffic within the I-85 corridor. The creation of rail service as an alternative for freight traffic has the potential to reduce existing and projected traffic noise levels, improve the area's air quality, and reduce overall costs of moving freight.

These modal strategies offer a strong potential for assisting motorists traveling within and through the study area while reducing the environmental consequences of future traffic growth.

8.11 SUMMARY OF MODAL STRATEGIES

The strategies previously discussed in this chapter are tabulated in Exhibit 64 along with additional details on cost and suggested implementation schedule. Many of the modal strategies could be initiated and implemented within just a year or two with relatively low cost. Other strategies have a much longer development horizon due to the time required for planning and cost. A number of these strategies could produce benefits in the near future while others may require a longer period to develop to the point of providing benefits to traffic. Many of these strategies are suitable for a collaborative effort between state and local government transportation agencies while some strategies are sufficiently low cost that a single agency could undertake one of the strategies. As an example, the construction of a single P&R lot could be funded by a single entity.

Many of the strategies have the potential to grow beyond the effectiveness shown in the table and taken as a whole these strategies can have a significant positive effect on the travel along the I-85 corridor. **Encouraging and providing a variety of modal options can delay or eliminate the need to widen the I-85 along the length of the corridor between Greenville and Spartanburg.** The beneficial impact of implementing modal strategies on the need to construct additional lanes on I-85 is evaluated in Chapter 10.

[See Exhibit 64: Modal Strategy Summary on next page]

Exhibit 64: Modal Strategy Summary

Label	Strategy	Recommendation	Benefits	Timing	Cost (x $1000)	Associated Strategies	Traffic Reduction (%)
M1	Commuter Rail	Prepare Feasibility Study	Reduces commuter traffic on I-85 Reduces emissions	2015	200	TDM2, TDM3, TDM4	3.4
M2	High Speed Passenger Rail	Plan for supporting infrastructure and intermodal transportation	Reduces traffic on I-85 Reduces emissions	N/A	N/A	TDM2, TDM3, TDM4, M1	2.8[1]
M3	Express Bus Service	• Provide Service from Greenville to GSP Airport • Provide Service from Spartanburg to GSP Airport • Use I-85 shoulders for bus lane, improve as needed	Reduces traffic on I-85 Reduces emissions Improves Mobility	2013 2015 2015	230 per year 350 per year Included in C33	TDM2, TDM3, M6, M8, M11, C33	1.9[2]
M4	Bus Rapid Transit	Provide Service on US 29 (a parallel route), improve signal operations to support bus transit • Phase 1 - Service from Greenville to Greer • Phase 2 - Services from Greer to Spartanburg	Reduces traffic on I-85 Reduces emissions Improves Mobility	2015 2025	190 per year plus upgrades of 2,700 250 per year plus upgrades of 2,300	M6, M7, M8, TDM7	0.2
M5	Ride Sharing Program	Partner with major employers to develop programs and educate employees on modal opportunities	Reduces traffic on I-85 Reduces emissions Promotes use of transit Reduces cost of transportation	2012	15	TDM4, M6	2.0
M6	Park and Ride Facilities	Develop Park and Ride Facilities at: • Augusta Road (existing transit services) • GSP Airport (transit service planned) • SC 101 (1.5 miles to transit service) • US 29 at I-85 (5.0 miles to transit service) • US 29 at Greer (transit service planned) • US 178 near Anderson • Cleveland Street at Spartanburg Develop P&R Website to include trip planner, transit information, and bike/pedestrian accommodations	Reduces traffic on I-85 Reduces emissions Encourages carpooling Promotes use of transit Promotes bicyclist and pedestrians	2013 2013 2013 2014 2015 2016 2017	1,150 580 435 725 150 580 360 10	TDM2, TDM4, M3, M5, M8	5.0
M7	Taxi and Limousine Service to GSP	No recommendation					0
M8	Bicycle and Pedestrian Opportunities	• Provide Bicycle Racks at all Park and Ride Lots • Provide Bicycle carriers on all transit buses •	Encourages bicycle use Reduce short local trips Improves health	2012	Included in M-6	M6, M11, TDM6	0
M9	Truck to Train Freight Opportunities	Encourage Norfolk Southern in development of Crescent Line (intermodal centers in Charlotte and Atlanta)	Reduces long-haul trucks on I-85 Conserves fuel Reduces emissions	2012	None	TDM7	1.1
M10	Truck Parking Areas	Develop truck parking areas at: • White Horse Road • SBL south of US 29 •	Reduces truck traffic during peak hours Reduces emissions Improves Safety	2015 2014	870 220		1.5
M11	Transit Service	Provide bus service to park and ride facilities at SC 101 and at US 29	Encourages use of Park and Ride Reduces congestion	2013	15 per year (SC 101) 45 per year (US 29)	M6, M8, TDM6	0.2
				TOTAL FOR MODAL STRATEGIES	**$11,375**		**11.9**

[1]The potential benefit of Commuter Rail is not included in the total as only a study is recommended.
[2]Benefits of high speed rail will depend on the number of stops allowed in SC. If only one stop is allowed the benefits to traffic on I-85 will be very small. If stops are allowed in both Spartanburg and Greenville, the potential benefits could be 2.8% reduction in traffic. However, this strategy will compete with the Commuter Rail and therefore is not counted in the total benefits of the modal strategies as it is unlikely that M1 and M2 will both be implemented. The total potential benefits can only be achieved through the implementation of all strategies. The total cost of implementing the strategies does not include the recurring operating or maintenance cost.

Chapter 9: Traffic Operational Improvements

Operational improvements are defined as improvements that aid in the flow of traffic on existing I-85 without adding additional lanes to the mainline of I-85. These strategies for operational improvements are generally relatively less expensive than adding lanes to the mainline. Operational improvements may include improvements to interchange ramps, highway signing, ITS equipment, safety treatments, pavement markings, and managed lanes. The operational strategies considered for the I-85 corridor are discussed in greater detail in this chapter.

9.1 INTERCHANGE RAMPS

Improvements to interchange ramps were considered based on providing sufficient length of ramp to safely merge or exit, and a sufficient number of lanes on the ramp to accommodate the volume of traffic on the ramp. The recommended ramp improvements are described below. Ramps included in interchange improvements are included in the discussion of the interchange improvements in Chapter 10, Capacity Improvements.

Immediate Ramp Improvements (2015 or Earlier)

I-385/Woodruff Road CD Exit at I-85 SB (OP1)
This proposed improvement will provide a two-lane exit from I-85 southbound to I-385 northbound. This movement experiences high traffic volumes that create a backup on the interstate and would benefit from an additional lane on the exit ramp. This improvement could be made quickly and at a very low cost as there is sufficient pavement in place and only pavement marking and appropriate signage would be required. See Appendix A for conceptual improvement sketches.

SC 101 Acceleration lanes at I-85 NB and SB (OP2)
The northbound and southbound acceleration lanes from the loop ramps onto I-85 would be lengthened by restriping the ramp lanes. The current solid lines separating the ramp lanes from the mainline lane would be replaced with a dashed line to provide an additional merge length and improve safety. This is a quick and very low cost improvement as only pavement marking is required. See Appendix A for conceptual improvement sketches.

I-385/Woodruff Road CD Exit at I-85 NB (OP3)
The exit ramp would be reconstructed to provide a two-lane exit from I-85 northbound to the CD road for I-385 and Woodruff Road to accommodate the exiting traffic. The deceleration lane would also be lengthened to improve safety. See Appendix A for conceptual improvement sketches.

I-385/Woodruff Road CD Exit at I-85 SB (OP4)

This improvement would lengthen the deceleration lane from I-85 southbound to the I-385/Woodruff Road exit. This proposed improvement could be accomplished with or following the implementation of strategy OP1. This strategy could also be implemented in association with the addition of a fourth lane to the mainline (strategy C7) as described in Chapter 10. See Appendix A for conceptual improvement sketches.

Pelham Road Exits at I-85 NB (OP5) and SB (OP6)

This proposed improvement to the interchange includes adding a lane to both the I-85 northbound and southbound off-ramps to provide a two-lane exit and a two-lane ramp at each location. The deceleration lanes will also be extended to 1,200 feet with 300-foot tapers for both off-ramps. These improvements are needed to accommodate the heavy volume of traffic on these ramps and to improve safety by assuring that ramp traffic will not interfere with the mainline interstate traffic. The northbound exit ramp improvement could be combined with the addition of a fourth lane on I-85 northbound (strategy C6) as described in Chapter 10. The southbound exit ramp improvement may be combined with the addition of a fourth lane on southbound I-85 (strategy C9) as described in chapter 10.

Improvement of the I-85 northbound ramp to Pelham Road to a two-lane ramp provides sufficient lane capacity to handle the projected 2035 volume of traffic. As the two-lane ramp nears Pelham Road, it is recommended that two left-turn lanes be provided along with a third lane that will turn right. It is important for proper operation that the three lanes be developed for a sufficient distance along the ramp to prevent the vehicles turning right from blocking the vehicles desiring to turn left from entering the middle ramp lane.

Improvement of the I-85 southbound ramp to a two-lane ramp provides sufficient lane capacity to handle the projected 2035 volume of traffic. As the two-lane ramp nears Pelham Road, it is recommended that two right turn lanes be provided along with a third lane that will be provided for the left turn. It is important for proper operation that the three lanes be developed for a sufficient distance along the ramp to prevent the vehicles turning left from blocking the vehicles desiring to turn right from the middle lane.

Additionally, it will be important to the operation of the Pelham Road interchange that the signal system along Pelham Road be synchronized to allow the vehicles turning left from the I-85 NB exit ramp to make the turn and clear the interchange area as efficiently as possible. A study of the signals along Pelham Road was not undertaken as part of this report. Another option for moving the vehicles from the northbound exit lanes is to widen Pelham Road to three lanes in each direction. This would allow more vehicles to move through the interchange area and thus allow the vehicles turning left from the northbound exit ramp to clear the interchange. The widening of Pelham Road was modeled to determine its effects on the interchange operation. However, widening Pelham Road is not recommended as an improvement as the signal system adjustments appear adequate to move the traffic from the northbound exit ramp.

SC 290 Exits at I-85 NB (OP7) and SB (OP8)

An additional exit lane would be added to both the northbound and southbound I-85 off-ramps to form a two-lane exit and a two-lane ramp at both locations. These improvements are needed to accommodate the large truck volumes on the ramps and improve safety. These improvements could be made separate from the proposed reconfiguration of the interchange to a Diverging Diamond Interchange (DDI) as described for strategy C10 in Chapter 10. However if strategy C10 is implemented, the ramp improvements (OP7 and OP8) must be in place or constructed as part of C10.

US 29 at I-85 (OP11)

The deceleration lane for northbound I-85 exiting to US 29 would be lengthened to 1,200 feet with a 300-foot taper. Additionally, the acceleration lane from US 29 to southbound I-85 would be lengthened to improve operation and safety.

SC 129 at I-85 (OP12)

The deceleration lane for the northbound I-85 exiting to SC 129 would be lengthened to 1,200 feet with a 300-foot taper. Additionally, the acceleration lane from SC 129 to southbound I-85 would be lengthened to improve operation and safety.

Future Ramp Improvements (2020 or Later)

SC 14 Exit at I-85 NB (OP9)

An additional lane would be added to the northbound SC 14 exit. The deceleration lanes would be extended to 1200 feet with 300-foot tapers. These improvements would provide a two-lane exit and a two-lane ramp to accommodate the projected traffic volumes. This improvement (OP9) could be constructed prior to or in conjunction with the addition of a fourth lane between Pelham Road entrance ramp and SC 14 (strategy C8).

SC 14 Acceleration Lane at I-85 SB On-Ramp (OP10)

An additional lane would be added to the on-ramp from SC 14 to I-85 southbound to provide a two-lane entrance and a two-lane on-ramp. This on-ramp improvement anticipates that a fourth lane will have been previously added to the mainline of I-85 SB between SC 14 and Pelham Road (strategy C9) or will be constructed as part of this improvement.

Other Ramp Improvements

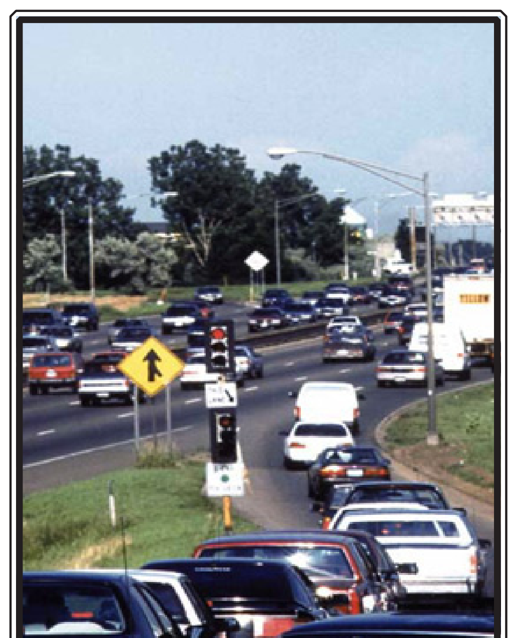
SC 14 at I-85 SB (C17)
This ramp improvement is considered a capacity improvement due to the cost and is described in Chapter 10.

Brockman-McClimon Road at I-85 NB (C21)
This ramp improvement is considered a capacity improvement due to the cost and is described in Chapter 10.

Ramp Metering

Ramp metering was considered for all interchanges in the corridor. Ramp metering is the use of a traffic signal deployed on a ramp to control the rate at which vehicles enter a freeway. Ramp metering can be an effective tool to address congestion and safety concerns at a specific point or stretch of freeway.

The majority of on-ramps currently operate in an efficient manner along the corridor. Two ramps warrant consideration for the use of ramp metering, Pelham Road southbound and Mauldin Road northbound.



The Pelham Road southbound ramp in 2015 is projected to have 1,438 vehicles merging with a mainline volume of 4,215 in the AM and 1,137 vehicles merging with 5033 on the mainline in the PM. The merging area operates at a current LOS F in the AM and PM peak hours. An important consideration when considering ramp metering is the available storage for the metered vehicles. The Pelham Road ramp has two lanes for a significant distance and should accommodate the backups if a dual lane metering system is used. The volumes would also require a dual lane system.

The northbound ramp from the Mauldin Road CD has 1,547 vehicles merging with 2,978 vehicles on the mainline in the AM and l,825 vehicles merging with 2,868 vehicles on the mainline in the PM. The merging area operates at a LOS D in the AM and PM peak hours. Ramp storage is adequate on this ramp and the volumes would dictate a dual lane system. A possible drawback for metering this ramp would be that there are approximately 100 trucks entering I-85 in both peak hours and the ramp is on an upgrade entering I-85. Based upon the acceptable LOS on this ramp and the concern for truck traffic acceleration issues, ramp metering is not recommended for this ramp.

In summary all ramps in the corridor were considered for ramp metering, and the Pelham Road Southbound ramp appears to be the only ramp that ramp metering could provide a benefit. It should be noted, however that the planned construction of an additional southbound lane between Pelham Road and I-385 should relieve the merging issue. Due to the limited potential application of ramp metering and lack of local experience with ramp metering in the state, it is not recommended that ramp metering be pursued on this corridor.

9.2 SIGNING AND PAVEMENT MARKINGS

Mainline Signing (OP13-16)

I-85, throughout the study area, is a minimum of three lanes in each direction with interchanges closely spaced throughout the corridor. The MUTCD strongly recommends that directional signs be mounted overhead for a freeway with these characteristics. Since I-85 was widened to three lanes in a piecemeal fashion the overall signing has not been upgraded to meet current standards.

The use of overhead signing with pull through signing at major interchanges is recommended. In addition there are several interchanges that will need double lanes exiting I-85 and the 2009 MUTCD has made major changes in the signing sequence for dual lane exits.

Converting all existing ground mounted signs with overhead signs would be very expensive and is not recommended at this time. As each section of I-85 is re-signed, consideration should be given to moving more signs overhead. In the highly congested areas, however, it is recommended that a project be developed to update all signs to current standards.

From US 25 to Mauldin Road, signs were updated several years ago to current standards and no changes are recommended at this time. It should be noted that these signs meet the standards set forth in the 2009 MUTCD.

From US 276 (Laurens Road) to Pelham Road, signing plans should be developed to convert all mainline guide signs to overhead structures. Signing plans should be designed to accommodate the future design of the I-85/I-385 interchange and the addition of dual lane exits at I-85/I-385 and I-85/Pelham Road.

From SC 14 to SC 129 any future signing plans should include provisions for overhead signs on the mainline and meet the requirements of the latest edition of the MUTCD.

Recommendations for immediate and intermediate (2015) signing improvements are detailed below:

- Install overhead sign on I-85 SB approaching I-385 to accommodate the dual lane exit to I-385. (OP13)
- Install overhead signs on NB and SB I-85 approaching Pelham Road to accommodate the proposed dual exits for Pelham Road. (OP14)
- Install new cantilever sign structure on I-85 NB approaching the Brockman-McClimon Road interchange. (OP15)
- Install new cantilever sign structure on I-85 SB south of the Brockman-McClimon Road interchange for the SC 14 and GSP interchanges. (OP16)

Crossing Route Signing

In general signing on the crossing routes is in good condition and meets current standards. Pelham Road, Laurens Road and US 29 are the exception and a project is recommended to provide overhead crossing route signing at these interchanges. Specific recommendations are detailed below:

- Pelham Road signing improvements include constructing 6 new overhead cantilever structures at a cost of $300,000 plus right of way if needed. (2012) (OP17)
- US 29 signing improvements include 6 new overhead cantilever structures at a cost of $300,000 right of way is available for these structures. (2012) (OP18)
- US 276 (Laurens Road) signing improvements include the installation of 6 new overhead cantilever structures at a cost of $300,000. New right of way could be required for 2 of the structures. (2012) (OP19)

Although the crossing route signing for SC 290 is adequate for current conditions, if the diverging diamond interchange is constructed major signing revisions will be needed. The proposed signing would cost approximately $600,000. (OP20)

Pavement Markings

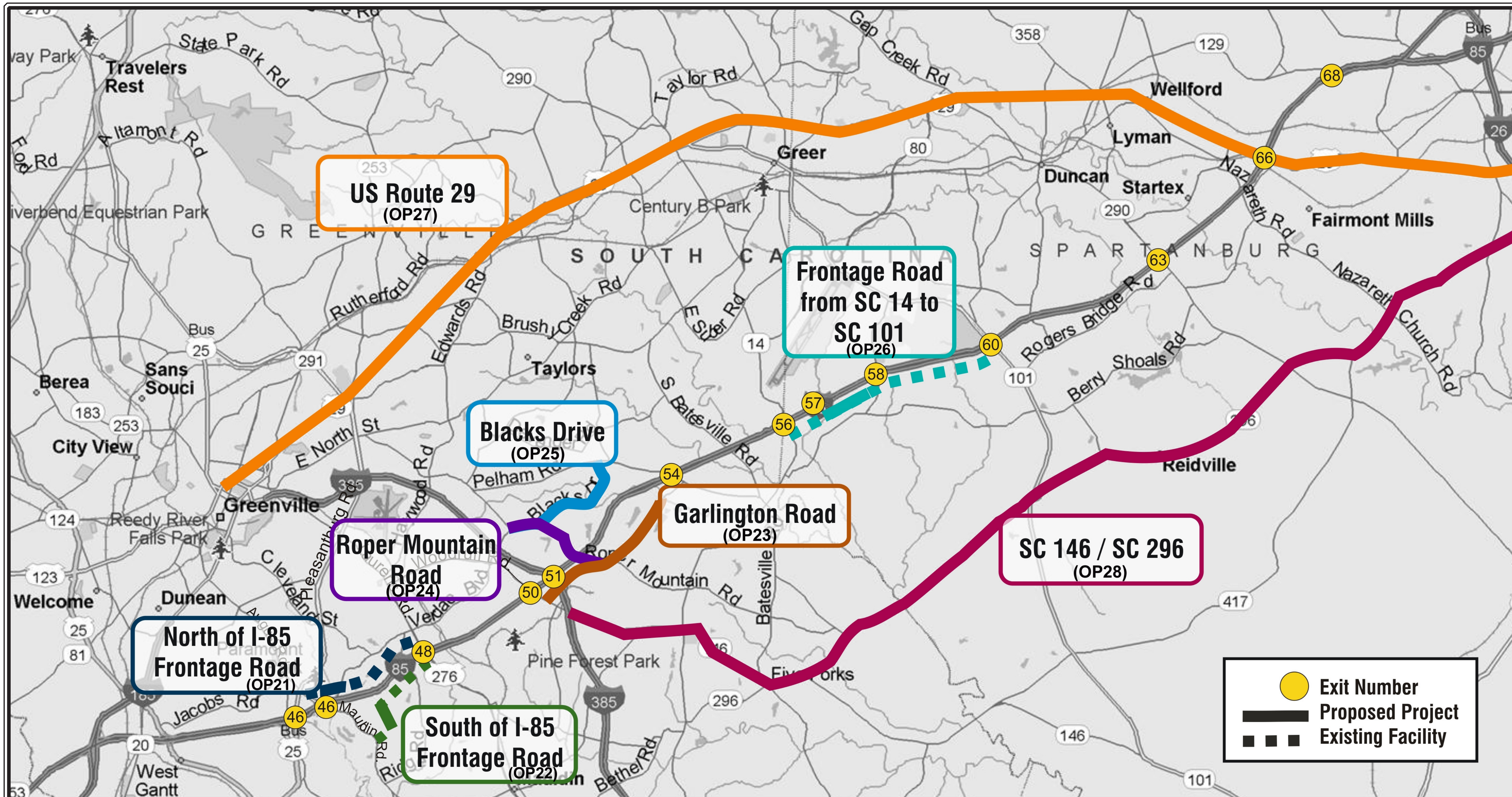
In general the pavement markings throughout the study area are maintained in very good condition. SCDOT has a regular replacement program for long line markings and raised pavement markers. One suggestion for pavement marking improvements was to mark a solid lane line approaching interchanges to discourage lane changes in the interchange area. This concept may have some merit and should be considered for evaluation at an interchange selected by SCDOT. Additionally, the use of directional arrows is recommended in conjunction with the construction of ramps and lane improvements.

9.3 PARALLEL ROUTE OPPORTUNITIES (OP21-29)

Various improvements to the roadway system in the study area were considered to provide alternative routes for traffic (see Exhibit 65). Improvements to alternative routes, parallel routes and frontage roads may induce more local traffic to travel on these routes and thereby relieve congestion on I-85.

A complete streets concept should be considered for all proposed alternative route concepts. The complete street concept incorporates bike, pedestrian, transit and car facilities. The complete street concept creates a network of roads that serve all users.

Exhibit 65: Alternative Routes



Alternative Route Strategies

Mauldin Road to Laurens Road North of I-85 Frontage Road (OP21)

North Kings Road could be extended approximately 0.25 miles to Duvall Drive in order to connect the two roads and make one continuous frontage road running along I-85. This proposed project would require a bridge across Parkins Mill Road and the Reedy River. The estimated cost of this project is $3,430,000.

Mauldin Road to Laurens Road South of I-85 Frontage Road (OP22)

A 0.25 mile connector road from Dairy Drive to Wrenwood Road could be constructed. This project would connect Mauldin Road with Laurens Road. Both industries and rolling terrain in the project area would need to be considered. The estimated cost of this project is $1,410,000.

Garlington Road Widening (OP23)

The widening of 3.3 miles of Garlington Road from Pelham Road to I-385 could provide an alternative route to I-85. The project would be restricted, where Garlington Road goes under I-385, by the existing bridge. The widening of Garlington Road from Woodruff Road to Roper Mountain Road is in the GPATS long range plan. The estimated cost of widening this segment to four lanes is $19,000,000.

Roper Mountain Road Widening (OP24)

Roper Mountain Road from Garlington Road to Farringdon Drive should be considered as an alternative route to I-385 and I-85. The widening would be approximately 1.8 miles in length and would require the widening of an existing bridge over I-85. The estimated cost of widening this segment to four lanes is $13,000,000.

Blacks Drive Widening (OP25)

Blacks Drive from Pelham Road to Roper Mountain Road should be considered as a parallel road to I-85. The intersection with Roper Mountain Road would need to be improved to provide a better alignment. The section to be widened is approximately 1.9 miles long and requires the widening of a bridge. This project should be considered in conjunction with the Roper Mountain Road project (OP29). The estimated cost of widening this road to four lanes is $12,000,000.

Frontage Road from SC 14 to SC 101 (OP26)

To provide a frontage road from SC 14 to Brockman-McClimon Road, East Frontage Road would need to be extended from where it currently ends to Freeman Farm Road. This extension would be approximately 1.5 miles in length and would run parallel with I-85. Between Brockman-McClimon Road and SC 101 existing facilities such as Jones Road and Freeman Farm Road could be utilized to develop a frontage road. Potentially, short segments of new roadway could be incorporated for a more direct route. The estimated cost of this project is $8,460,000.

US 29 (OP27)

US 29 from Greenville to Spartanburg, which is approximately 26 miles long, has been considered as a northern alternative to I-85. Although this road is not close enough to I-85 to attract traffic from I-85 on a typical day, US Route 29 could be used to manage incidents on I-85. Upgrades would need to be made to existing traffic signals and signal systems along this route. There are approximately 43 signalized intersections in the study area. Video detection equipment should also be utilized along this corridor to maximize the control and management of traffic in this area. Video cameras would provide real-time traffic data that could be used by the SCDOT Traffic Management Center to route traffic accordingly. This capability would be very beneficial in the event of a major incident that required closure of I-85 and would also be beneficial to drivers as it improves the overall network of roads in the area. This type of improvement could not be modeled in the GPATS model. The estimated cost of this project is $1,720,000.

SC 146/SC 296 (OP28)

SC 146, in conjunction with SC 296, could be utilized as a southern alternative route to I-85. SC 146 from I-385 to Five Forks is approximately 4-miles long and SC 296 from Five Forks to I-26 is approximately 18-miles long. Improvements need to be considered along this route such as upgrading existing traffic signals and signal systems. There are approximately 11 signalized intersections along this route. Also, video detection equipment should be considered in areas where deemed appropriate to maximize traffic management and control. Video cameras would provide real-time traffic data that could be used by the SCDOT Traffic Management Center to route traffic accordingly. This capability would be very beneficial in the event of a major incident that required closure of I-85 and would also be beneficial to drivers as it improves the overall network of roads in the area. This type of improvement could not be modeled in the GPATS model. The estimated cost of this project is $440,000.

Woodruff Road, Verdae Boulevard and Laurens Road (OP29)

Woodruff Road, Laurens Road and Verdae Boulevard could be used collectively to divert some trips from both I-85 and I-385. Signing would be needed to encourage the use of Woodruff Road, Verdae Boulevard and Laurens Road instead of the segment of I-385 between Woodruff Road and I-85 and the segment of I-85 between I-385 and Laurens Road. This type of improvement could not be modeled in the GPATS model but would be a low cost way of aiding drivers in using local roads for local trips. It is estimated that this project would cost less than $500,000.

Millennium Boulevard/Carolina Point Parkway

Millennium Boulevard/Carolina Point Parkway runs parallel to I-85 and was considered as an alternative route. However, due to multiple roundabouts on Millennium Boulevard and Carolina Point Parkway, this route is not deemed a reasonable alternative to I-85.

Extension of Southern Connector east to I-85

The existing Southern Connector could be extended and used as an alternative route to I-85. This project would be cost prohibitive due to the project scale and the low volumes on the existing section. New or improved routes that could compete with the Southern Connector should also be avoided in this corridor. This alternative route was not pursued further in this study.

Alternative Route Evaluation

The GPATS 2030 model was used to evaluate the alternative route projects considered viable by the study that include road widening or new road facilities. The model is a transportation demand model that gives results in AADTs. For modeling purposes, the improvements were evaluated in three groups based on location. Operational improvements such as signal system upgrades could not be modeled with the regional model. A summary of the results of the evaluation are provided in Exhibit 66.

The potential reductions in traffic along these three segments of I-85 are not cumulative as they serve local traffic in distinctly different locations. However, the potential benefits are significant, particularly in the heavily traveled segments from I-385 to Pelham Road and from SC 14 to SC 101.

Exhibit 66: Alternative Route Evaluation

I-85 Location/Project	Parallel Length of I-85	Cost	Average Daily Traffic (ADT)			
			No-Build	Build	Change	% Change
Mauldin Road - Laurens Road	2.6 miles		44,200	44,000	-200	-0.5%
North Frontage Road		$3,430,000				
South Frontage Road		$1,410,000				
I-385 - Pelham Road	2.9 miles		72,400	70,000	-2,400	-3.3%
Garlington Road		$19,000,000				
Roper Mountain Road		$13,000,000				
Blacks Drive		$12,000,000				
SC 14 – SC 101	4.0 miles		70,900	67,300	-3,600	-5.0%
South Frontage Road		$8,460,000				

Mauldin Road – Laurens Road

The improvements creating a frontage road between Mauldin Road and Laurens Road north of I-85 produced a very modest effect on the traffic assignments. The daily traffic volume on I-85 decreased by approximately 0.5%. There were also some volume reductions on the collector-distributor roads in the vicinity of the improvements. The model did not assign any traffic to the frontage road south of I-85.

I-385 – Pelham Road

The improvements between I-385 and Pelham Road include the Blacks Drive, Roper Mountain Road, and Garlington Road projects. These projects had a significant positive effect in reducing traffic on I-85. The daily traffic on I-85 decreased by approximately 3.3%.

SC 14 – SC 101

The frontage road project that would connect SC 14 to SC 101 south of I-85 had the greatest impact on I-85. It resulted in a decrease in daily traffic of approximately 5.0%.

9.4 CLOSING OR RESTRICTING INTERCHANGE MOVEMENTS

With 15 interchanges along the corridor, the possibility of closing an interchange or restricting some of the interstate entrance or exit ramps was reviewed. Interchanges where closure or ramp restrictions may be appropriate are those interchanges that are in close proximity of another interchange. The purpose of closing an interchange or ramps is to promote better traffic operations, not to prevent motorist from using the freeway. Five (Augusta Road, Pleasantburg Drive, Mauldin Road, Woodruff Road and I-385) of the 15 interchanges are served by two separate C-D road systems, which effectively removes 12 entrance or exit ramps from the mainline of I-85. Of the remaining interchanges, none appear to be good candidates for closure or ramp restrictions due to heavy volumes of traffic and the need for access.

9.5 MANAGED LANES (OP30-31)

Managed lanes (as shown in Exhibit 67) involve the regulation, warning, guidance and redistribution of traffic to meet overall transport goals; such as, improving traffic operations, facilitating the movement of people and goods, improving safety, and generating revenue. Where managed lanes are implemented, certain freeway lanes are set aside for a variety of specific operating strategies intended to move traffic more efficiently in those lanes. As a result, travelers have options in traveling on a congested freeway.

Exhibit 67: Managed Lane

Managed Lanes Design Categories

Contraflow Lanes

Contraflow lanes operate in the opposite direction of adjacent lanes where vehicles travel on the "wrong" side of the highway with barriers separating them from oncoming traffic. Contraflow lanes were considered as inappropriate for the I-85 corridor due to safety concerns, the relatively even directional split in traffic, and the expense associated with the barriers.

Concurrent Flow

Concurrent flow lanes lie adjacent to and operate in the same direction as general purpose lanes. The managed lane is normally the inside lane or shoulder lane. Often they are not physically separated from the other freeway lanes. Pavement markings are a common means used to delineate these lanes. A sample photo is shown in Exhibit 68. This study assumes implementation of concurrent flow managed lanes along the I-85 study corridor and discusses these in more detail as HOV and HOT lanes.

Exhibit 68: Concurrent Flow

Courtesy of VDOT

Reversible lanes

Reversible lanes, usually placed in the highway median, run in one direction in the morning, then in the opposite direction in the afternoon. They usually operate inbound toward the central business district and other major activity centers in the morning, and outbound (i.e., the reverse direction) in the afternoon. Some type of daily set up (for reversing directions) is required with reversible facilities. Reversible lanes were considered as not appropriate for the I-85 corridor due to the relatively even directional split in traffic and the expense associated with the barriers.

Barrier Separated Lanes

Barrier Separated Lanes are managed lanes separated from adjacent lanes by a physical barrier such as a concrete barrier wall. They require more right of way but studies have shown them to be safer. Concurrent flow, contraflow and reversible lanes can all be barrier separated. Barrier separated lanes were considered not appropriate for the I-85 corridor due to the expense and safety issues related to providing ingress and egress to the separated lanes.

Managed Lanes Operational Categories

HOV Lanes (OP30)

An HOV is a motor vehicle carrying two or more persons. An HOV can consist of a group of individuals within the same family traveling together and can also include carpools, vanpools, and buses. An HOV facility is any type of treatment that gives priority to HOVs, including freeway lanes and other elements.

Individual HOV facilities may require different vehicle occupancy levels depending on the corridor traffic demand. Consequently, the use of the HOV facility may require a vehicle that contains two or more people (HOV+2), three or more people (HOV+3), or four or more people (HOV+4). In these cases, vehicles carrying fewer people than the designated occupancy are prohibited from using the HOV facility and can be cited and fined by the enforcing agency. It is also worth noting that some jurisdictions permit the use of HOV facilities by certain preferential users. For example, some areas permit hybrid single occupant vehicles (SOV) to use HOV facilities without penalty to promote the use of low emission vehicles.

Objectives of HOV Lanes

The primary concept is to provide HOVs with both travel time savings and more predictable travel times. These two benefits serve as incentives for individuals to choose a higher-occupancy vehicle mode over driving alone. The person-movement capacity of the roadway is increased by carrying more people in fewer vehicles. In some areas, additional incentives, such as reduced parking charges or preferential parking for carpools and vanpools, have been used to further encourage individuals to change their driving habits. The intent of HOV facilities is not to force individuals to make changes against their will. Rather, the objective is to provide a cost-effective travel alternative that a significant volume of commuters will find attractive enough to change from driving alone to using a high-occupancy mode.

Benefits of HOV lanes

A list of the potential benefits for using the HOV facilities is provided as follows:

- Substantial travel time savings may exist in comparison to general purpose lane travel.
- HOV lanes may operate more reliably than general purpose lanes.
- HOV lanes may successfully move large numbers of travelers, particularly in the peak periods when general purpose lane congestion is highest.
- Encourages peak period travelers to take advantage of ride sharing (transit and carpool) travel modes.

Physical Improvements Needed for HOV Implementation on I-85

The conversion of the existing inside (median) lanes of the six-lane freeway to HOV lanes is not practical as this will increase congestion by placing additional traffic in the remaining two general use lanes on each side of the freeway. In order to implement the HOV lane concept within the I-85 study corridor the addition of a fourth lane in each direction will be required. Typically double lines are used to separate the HOV lanes from the General Purpose lanes. As mentioned earlier, the inner lane or the median lane of the widened or expanded I-85 corridor (8-lane facility) would be dedicated as the HOV lane along both directions of travel. Exhibit 69 shows a typical section that includes the added HOV lanes. This same typical section is also applicable to the addition of HOT lanes as discussed in more detail later in this chapter.

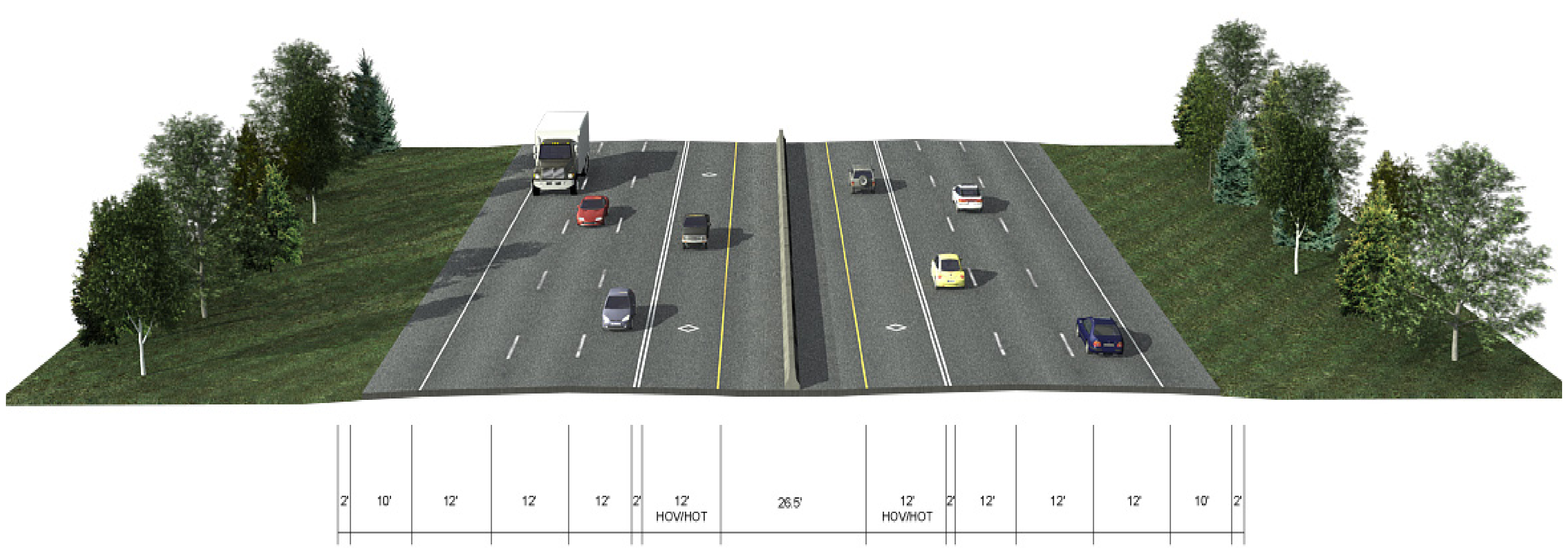
HOV Operations and Planning Policies:

The numerous issues associated with policy development, planning, designing, implementing, marketing, operating, enforcing, and evaluating HOV facilities are addressed in the NCHRP "HOV Systems Manual." The development of an operations plan is foremost in the success of the HOV facility. It should be noted that the development of an operations plan cannot be done in isolation, but needs close integration with the facility's enforcement plan. The plan should also address the various policy issues associated with HOVs, including those discussed below.

Operational Alternatives for the HOV

The type of HOV facility has a direct and significant impact on other elements of the plan such as the ingress and egress and enforcement. The facility can be restricted to HOVs during peak periods only or throughout the day. In addition to these features, this type of facility should also have a system of changeable message signs (CMS) that inform commuters as to the operational status of the facility.

Exhibit 69: Eight-Lane Freeway with HOV/HOT Lanes



Hours of Operation

Hours of operations for an HOV facility may be characterized as (a) 24-hour continuous use, (b) extended morning and afternoon hours – in this scenario, the lanes are used for much of the morning and afternoon, (c) Peak Period only, (d) Dynamic – only when warranted.

A number of factors, including geometric design, volumes of HOV and mixed-flow traffic, hours of congestion, and regional consistency will influence HOV operating hours. Twenty-four hour HOV use of priority facilities is sometimes preferred, because violations tend to be lower and there is less motorist confusion. Also, 24-hour use may provide a greater overall incentive for the formation of new carpools. Part-time operation provides benefits only during the peak hours of defined need, allowing all traffic to use the lanes during other periods. This approach can reduce enforcement requirements and minimize public criticism during periods when the HOV lane appears empty. For the purpose of this study, HOV Lanes are assumed to operate during the peak periods only; between 7:00AM to 9:00 AM in the morning and 4:00 PM to 6:00 PM in the afternoon.

Vehicle Eligibility Requirements

The HOV facility provides operators and managers the flexibility to match the vehicle eligibility and the vehicle occupancy requirements to the lanes. Further, each can be changed to maintain the proper balance if necessary. Vehicle eligibility (i.e., what types of vehicles can use the facility) is one of the first issues that must be determined to develop the Operations Plan. Various types of vehicles can be considered for the use on the HOV facility including, buses, vanpools, carpools, taxis, emergency vehicles, low-emission vehicles, commercial vehicles, airport shuttles and other services, motorcycles, and tolled vehicles.

Vehicle Occupancy Enforcement

Enforcement of vehicle-occupancy requirements and other policies are critical to the successful operation of HOV facilities. HOV enforcement programs help ensure that operating requirements, including vehicle-occupancy levels, are maintained to protect HOV travel time savings, to discourage unauthorized vehicles, and to maintain a safe operating environment. Visible and effective enforcement promotes fairness and maintains the integrity of the HOV facility to help gain acceptance of the project among users and non-users.

Public acceptance of an HOV project is closely linked to the perception that the facility is well used and that the vehicle occupancy requirements are enforced. Support for an HOV facility will be lessened if commuters traveling in the adjacent freeway lanes feel the privilege of using the HOV lanes is being abused. Visible ongoing enforcement must be provided. Detection and apprehension of violators, and effective prosecution of violators, are essential.

Performance of HOV Lanes in other Locations

High-Occupancy Vehicle (HOV) lanes are common throughout the United States. There is a growing body of evidence suggesting that efficient and effective management of existing HOV lanes is both achievable and sustainable through applications including managed lanes and electronic toll collection.

The study, A Review of HOV Lane Performance and Policy Options in the United States was performed by FHWA in December 2008. In the study, HOV owners nationwide were contacted to discuss the performance of existing HOV lanes, if and why owners are considering policy changes, and their future expectations. Based on respondents representing 10 states and over 70 HOV facilities, the primary objectives of HOV lanes are to maximize person throughput, manage congestion, and provide an option for travel time savings and reliability. Over 80% of respondents actively monitor system performance. Most respondents indicate that HOV lanes are currently meeting performance objectives. For HOV lanes that are not performing adequately, the primary concerns are overcrowding, low speeds, lack of a continuous system, and enforcement issues.

Under utilization, or "empty-lane syndrome," is another common performance issue nationwide that has led to policy changes on HOV systems. Inadequate speed differential is also noted in some areas as it relates to geometric design, where a buffer separation results in lane friction between the HOV lane and the slower moving general-use lanes and impacts the HOV lane driver's tendency to drive at free-flow speeds. The results of the HOV operator survey and interviews revealed similar operational challenges and common categories of performance characteristics across HOV systems nationally.

HOV Lanes Summary

The conversion of the existing inside lanes of I-85 to HOV lanes will increase congestion and travel time. Therefore, the conversion of existing lanes to HOV is not a viable strategy. The construction of an additional lane in each direction to be designated as HOV lanes would have a beneficial effect on traffic operations by providing additional highway capacity. While the construction of additional lanes for HOV purposes is discussed as a managed lane strategy, this potential project is also a capacity strategy.

The construction of HOV lanes was evaluated using VISSIM. While the addition of HOV lanes does produce benefits to traffic, a comparison of an eight-lane HOV freeway with an eight-lane general use freeway shows that the general use freeway will have greater benefits with regard to reducing congestion. (See additional discussion in Chapter 10.)

HOT Lanes (OP31)

One of the most recent lane management concepts is HOT lanes. This concept combines both HOV and pricing strategies by allowing vehicles that do not meet passenger occupancy requirements to gain access to HOV lanes by paying a toll. The lanes are "managed" using price and occupancy restrictions to manage the number of vehicles traveling on them. HOT lanes maintain volumes consistent with uncongested levels of service even during peak travel periods. Some of the unique attributes of HOT lanes (relative to HOV) include:

- Pricing Systems: In order to maintain superior traffic service conditions, toll levels are set to limit the number of users by willingness to pay. The fee structure may be fixed, varying by time of day, or varying in response to real-time traffic conditions. In either case, higher tolls are charged during peak demand periods. Information on toll levels is conveyed to motorists through variable message signs located near entry points.
- Toll Collection Procedures: In order to avoid the delays associated with manual toll collection, HOT lanes rely on electronic payment systems or paid monthly passes. Therefore, only those vehicles equipped with a transponder tag or valid permit may use the lanes.
- Vehicle Type: A range of management policies may be implemented related to vehicle type. Depending on local transportation goals, low-emission vehicles, motorcycles, emergency vehicles, transit vehicles, taxis, and/or trucks may be allowed to use a HOT lane, either at no cost or for a reduced fee.

Objectives of HOT Lanes

HOV lanes typically operate at less than full capacity. The objective of HOT Lanes is to utilize the excess capacity of HOV lanes. The excess capacity for HOV lanes can be used to manage overall roadway congestion. The key to effective use of this strategy is to actively manage, using dynamic toll collection, how many vehicles can use the HOT lane. This keeps a congestion free incentive for carpool and transit vehicles, while at the same time fully utilizing the facility.

Managing the excess capacity of a facility is accomplished by charging a dynamic (varying rate) toll for access, with tolls set by the level of congestion as well as vehicle class. The motorist has the option of paying for a congestion free restricted freeway lane or traveling free on a congested general purpose freeway lane. Based on a study; "A Guide for HOT Lane Development"; Perez, B. & Sciara, G.; FHWA; 2001, approximately 70% of the nation's HOV lane miles operate with peak hour volumes of between 900 and 1,500 vehicles/hour. The combined ability of HOT operations to introduce additional traffic to existing HOV facilities, while using price and other techniques to better manage and control the number of additional motorists and maintain high service levels, renders the HOT lane concept a promising means of utilizing this available capacity.

Benefits of HOT Lanes

The benefits of this concept are:

- It expands mobility options in congested urban areas by providing an opportunity for reliable travel times to users prepared to pay a significant premium for this service;
- It generates a new source of revenue which can be used to pay for transportation improvements, including enhanced transit service; and
- It improves the efficiency of HOV facilities, which is especially important given the recent decline in HOV mode share in 36 of the 40 largest metro areas.

Physical Improvements Needed for HOT Implementation on I-85

Implementation of the HOT lane concept requires more physical improvements compared to the HOV lane concept. The electronic toll collection (ETC) reader antennas, vehicle enforcement system (VES) camera and variable message signs showing the toll rates at the access points will be required for this HOT lane concept.

Most HOT lanes are created within existing general-purpose highway facilities and offer potential users the choice of using general-purpose lanes or paying for premium conditions on the HOT lanes. HOT lanes utilize electronic toll collection and traffic information systems that also make variable, real-time toll pricing of non-HOV vehicles possible. Information on price levels and travel conditions is normally communicated to motorists via changeable message signs, providing potential users with the facts they need in order to decide whether or not to utilize the HOT lanes or the parallel general-purpose lanes that may be congested during peak periods. HOT lanes may be created through new capacity construction or conversion of existing lanes.

Conversion of existing HOV lanes to HOT operation is the most common approach. This study assumes that an additional lane would be added in each direction with the median lane or the inner lane of I-85 dedicated as the HOT lane in both directions. Conversion of an existing general purpose lane to HOV or HOT operation would create additional congestion by reducing overall highway capacity.

The HOT lane facility would begin north of SC 129 interchange and end south of the Augusta Road interchange. Motorist will have to enter or exit at selected locations indicated by the lane markings.

This study only focuses on a preliminary HOT lane operational analysis with a single access point (ingress/egress). The access point to the HOT facility will be located south of Augusta Road and north of SC 129 (Fort Prince Road). Detail traffic operational analysis with multiple access points within the study boundary is recommended for future studies.

Performance of HOT Lanes in other Locations

There are a total of eight highways in seven different states within the United States where the HOT lane concept is currently under operation. Additionally, eleven other highways in nine different states are currently evaluating the feasibility of introducing the HOT lane concept. (See Exhibit 70.)

The second year performance summary at SR 167 in Seattle, WA was obtained from WSDOT website. According to WSDOT, the first two years of the State Route 167 HOT lane project have yielded significant results – both for the drivers who access the HOT lanes and for those who use the general purpose lanes. People who opt to use the HOT lanes save time and minimize stress associated with their daily commute, while also reducing the burden of traffic in the general purpose lanes. The end result – free flowing traffic – benefits everyone traveling on SR 167, and illustrates how a better use of carpool lanes can effectively relieve congestion in vital corridors. The second year data indicate that the public is catching on to the benefits of HOT lanes: more people are using the HOT Lanes, and monthly revenue continues to climb. Current SR 167 HOT lane customers have become the strongest advocates, and have encouraged an expansion of the program.

Exhibit 70: Existing and Proposed HOT Lane Locations within USA

State	City	Route	Existing	Proposed
CA	Orange County	Route 91	X	
CA	San Diego	I-15	X	
CA	Oakland	I-680		X
CO	Denver	I-25, I-36 & C-470	X	
DC	Washington	I-95, I-395 & I-495		X
FL	Ft. Lauderdale	I-595		X
FL	Miami	I-95	X	
GA	Atlanta	I-75 & I-585		X
GA	Atlanta	I-85	X	
MN	Minneapolis	I-394	X	
NC	Raleigh	I-40		X
NY/NJ		Lincoln Tunnel		X
OR	Portland	Highway 217		X
TX	Austin	Loop 1		X
TX	Dallas	I-30 & I-635		X
TX	Houston	I-10 & US 290	X	
UT	Salt Lake	I-15	X	
VA	North	I-95 & I-395		X
WA	Seattle	SR 167	X	

Financial Feasibility of HOT Lanes

The projected volumes in the study corridor warrant the widening of I-85 from a six-lane section to an eight-lane section. The cost of constructing the additional lanes is estimated to be $253,700,000. The toll revenue from HOT lanes could off-set the cost of widening the interstate. In this section, the level of financing that could be supported by toll revenue is examined.

I-85 HOT Economic Model

A model was developed to examine the economics of the I-85 HOT Lanes. The model summarizes cost, revenues, and cash-flow over the life of the project and provides a rate of return. A summary of the various input values used for this study is provided in Exhibit 71.

Exhibit 71: Model Parameters and Assumptions

Model Parameters and Assumptions		
Timing	Construction Duration	3 years
	HOT Opening Date	January 2035
Costs	2012 Dollars	$253,700,000
	Construction Cost Index	4%
	HOT Startup	$2,000,000
	Operation and Maintenance (O&M) (2012 dollars)	$1,100,000 per year
	Subsidies (funding from other sources)	None
Traffic	Annual Growth Rate	1.88%
	HOT Lane Usage in peak hours	22.5%
	2035 Annual Volume	17,555,000 vehicles
Toll	HOT Traffic Share - One-passenger Vehicle	88%
	HOT Traffic Share - Two-passenger Vehicle	10%
	HOT Traffic Share – Three/+ passenger Vehicle	2%

Toll Assumptions

The one-passenger vehicle time-savings toll assumptions are provided in Exhibit 72. The 2010 values were established based on toll rates charged on HOT lanes currently in operation in other states. The time savings for one-passenger vehicles comes from the VISSIM model. Another way to view the toll rate is on a cost per mile basis. For example, the time savings of 14-19 minutes for traveling the 22 miles along the corridor is equal to approximately 16 cents per mile.

Exhibit 72: One-Passenger Vehicle Toll Assumptions and Traffic

Time Savings	2010	% of Traffic
0 minutes rate	$0.00	2.00%
0 - 1 minutes rate	$0.00	7.00%
1 - 3 minutes rate	$1.00	21.00%
3 - 5 minutes rate	$1.50	20.00%
5 - 7 minutes rate	$2.00	18.00%
7 - 10 minutes rate	$2.50	13.00%
10 - 14 minutes rate	$3.00	8.00%
14 - 19 minutes rate	$3.50	5.00%
19 - 25 minutes rate	$4.00	3.00%
25 - 34 minutes rate	$5.00	2.00%
34 - 37 minutes rate	$5.00	1.00%

Financial Feasibility

The model was used to determine if the project would be financially feasible under the base scenario with the parameters set forth in the previous section. In addition, a sensitivity analysis was completed to estimate how variations in the input values would impact the financial feasibility of the HOT lanes.

Initial Economic Model

The HOT economic model was run with the assumption that no supplemental funding is available to subsidize the cost of constructing two additional lanes and operating them as HOT lanes. Therefore, the revenue generated from tolls on the HOT lanes is the only source of funding. Included in this initial model are the parameters and assumptions shown in Exhibit 71. Additionally, the initial model assumes that the added lanes would be operated as HOT lanes on weekdays for only four hours per day, two hours in the morning and two hours in the afternoon. The model assessed the financial feasibility of the HOT lanes by calculating a rate of return on the funds invested in constructing and operating the two additional lanes. The initial HOT economic model estimates a rate of return of -0.29%. This negative rate of return indicates that the initial funds invested in the construction and operation of the HOT lanes will not be recovered through the collection of tolls on the HOT lanes. In other words, funding in addition to the toll revenue will be needed to make the HOT lanes an attractive investment.

Sensitivity Analysis

The sensitivity analysis of the I-85 HOT lanes examined three significant variations in model input to determine the feasibility of HOT lanes under different cost and funding assumptions. The values in the model were adjusted to determine what impact on the rate of return the following changes would have:

- Operating and maintenance cost paid from other sources
- A subsidy being added to aid in funding the project
- The toll prices being increased

If the cost of operating and maintaining the HOT lanes (1,100,000 per year) were paid from other sources, the project pay-off would be achieved in 2074 and the rate of return would be a positive return of 0.03%.

A subsidy of approximately $30 million dollars is needed for a positive rate of return for the project. Subsidies of $30, $60 and $90 million dollar were tested in the model. The financial impacts of these changes are summarized in Exhibit 73.

Exhibit 73: Subsidy Sensitivity

	Base	$30 million	$60 million	$90 million
Pay Off Year	--	2074	2072	2070
Rate of Return	-0.29%	0.03%	0.40%	0.80%

The one-passenger toll prices were incrementally increased by $0.20 as shown in Exhibit 74. The two-passenger rate is equivalent to the 1-3 minute time saving rate. The higher starting prices of the tolls provided positive rates of return as shown in Exhibit 75.

Exhibit 74: Toll Sensitivity Analysis Pricing

Time savings	Base	Toll + $0.20	Toll + $0.40	Toll + $0.60
0 minutes rate	$0.00	$0.00	$0.00	$0.00
0 - 1 minutes rate	$0.00	$0.00	$0.00	$0.00
1 - 3 minutes rate	$1.00	$1.20	$1.40	$1.60
3 - 5 minutes rate	$1.50	$1.70	$1.90	$2.10
5 - 7 minutes rate	$2.00	$2.20	$2.40	$2.60
7 - 10 minutes rate	$2.50	$2.70	$2.90	$3.10
10 - 14 minutes rate	$3.00	$3.20	$3.40	$3.60
14 - 19 minutes rate	$3.50	$3.70	$3.90	$4.10
19 - 25 minutes rate	$4.00	$4.20	$4.40	$4.60
25 - 34 minutes rate	$5.00	$5.20	$5.40	$5.60
34 - 37 minutes rate	$5.00	$5.20	$5.40	$5.60

Exhibit 75: Toll Sensitivity

	Base	Toll + $0.20	Toll + $0.40	Toll + $0.60
Pay Off Year	--	2073	2071	2069
Rate of Return	-0.29%	0.15%	0.57%	0.96%

HOT Lanes

At this time, no funding sources have been identified for the widening of I-85. Based on this initial financial analysis, the project will not be financially feasible under the set of parameters used for the base analysis of this study. Should public funding be made available, a more detailed investigation into the potential benefit of HOT lanes should be made. HOT lanes provide a method of funding additional capacity on the interstate system and also encourage a more efficient use of road capacity through carpooling.

Truck-Only Lanes

For almost 40 years, transportation planners have debated the efficacy of separating traffic into lanes reserved for passenger vehicles and others kept solely for trucks. Today, two principal objectives underlie the argument for designating special-purpose or managed lanes on interstates. One purpose is to separate heavy trucks from lighter vehicles on major truck corridors. The second is to create lanes on urban freeways that are reserved for high-occupancy vehicles and exclude trucks.

Types of Truck-Only Lanes

Proposals for the construction of truck-only lanes vary in design and capital cost, but three general designs have been discussed most often.

- Two additional lanes in each direction for heavy trucks only: These lanes would be separated from existing lanes by barriers. Existing lanes would be limited to passenger vehicles.
- One additional lane in each direction that would be limited to heavy trucks: A breakdown lane for trucks every few miles would be provided ever few miles. Where feasible, the added lane would be located in the median, with a concrete barrier separating traffic flowing in opposite directions. Another barrier would separate the truck lane from existing passenger vehicle lanes.
- One additional lane, for a total of four lanes in each direction. The right lane in each direction would be limited to trucks, the left two lanes to other types of vehicles, and the next to the right lane could be used by both groups.

Cost and Financing of Truck-Only Lanes

In principle, the concept of truck-only lanes has fairly broad appeal, but such lanes would be expensive to construct. Robert W. Poole, Jr. and Peter Samuel[5] estimate that, in general, constructing a truck-only facility alongside an existing rural interstate would cost approximately $2.5 million per lane-mile (about $10 million per route-mile for two lanes in each direction), plus land acquisition costs, if applicable. The cost would vary considerably, depending on right of way availability, topography, the need for overpass reconstruction for heavier gross vehicle weights, number of entrance and exit ramps needed, and a host of other factors. Costs in densely developed urban areas could be much higher.
Adding truck-only lanes to existing highways would be expensive enough that State and local DOTs are unlikely to find sufficient resources to fund them using traditional sources, such as a State's road-use tax fund. Therefore, tolls would likely be assessed on users of the improved facility.

In this study, the design year traffic projection shows that there will be approximately 12% trucks during the peak hour of traffic. Increasing highway capacity 30% by adding a single truck lane in each direction is not practical to accommodate 12% of the peak hour traffic. Therefore, a separate truck-only lane concept was not considered as a viable candidate in evaluating the alternatives.

Express Lanes

An Express Lane is a lane or set of lanes forming a separate roadway with a limited number of entrance and exit points as part of a major highway, often as part of a local Express Lane system with separate local or collector traffic lanes. Express lanes may be designed so that the direction of travel can be reversed at different times of day. The term "express lanes" is also used for HOT lanes. Various cities in the US have express lanes. Examples are I-5 in Seattle, I-15 in San Diego, I-15 in Salt Lake City, I-25 and I-36 in Denver, I-70 in St. Louis, I-90 and I-94 in Chicago, I-95 in Miami, and I-96 in Detroit. Express Lanes (barrier separated lanes) are not recommended due to the high volume of local traffic and the additional expense associated with the construction of barrier separated lanes.

9.6 ITS

As main traffic arteries become more congested and the cost of providing additional capacity outstrips the funding available for lane additions, it becomes necessary to better manage traffic on the existing highway facilities in order to maximize the efficiency and effectiveness of these facilities. This study will discuss traffic management on I-85 from two perspectives: 1) Existing Traffic Management and 2) Active Traffic Management.

Existing Traffic Management (OP32)

SCDOT has a Traffic Management Center (TMC) located in the Greenville District Office. The center is manned from 7:00 AM to 7:00

[5] R. W. Poole, Jr. and P. Samuel, Corridors for Toll Truckways: Suggested Locations for Pilot Projects, Reason Foundation, Policy Study 316, February 2004.

PM Monday through Friday, 8:00 AM to 6:00 PM on Saturdays and 8:00 AM to 4:00 PM on Sundays.

The TMC is responsible for communicating with the SC Highway Patrol for all incidents on the interstate system. The TMC also has contact with fire, hazmat, and other emergency responders to assure that the proper responders are aware of any highway emergency.

The primary source of information for the TMC is the system of cameras along the roadway. By constantly monitoring the cameras, the TMC is able to dispatch SCDOT incident responders to assist disabled motorists for routine items such as flat tires, refueling or other items which do not involve law enforcement or call the Highway Patrol for major incidents.

In the study area there are 15 traffic cameras in Greenville County and 19 cameras in Spartanburg County. Additional camera coverage in some areas would prove very helpful to the TMC, particularly in the Greenville County portion of the study area. Although the final decision for the placement of cameras would best be left to the TMC and incident responders it appears that the area between US 25 and SC 291 would benefit from greater camera coverage as well as the area between US 276 (Laurens Road) and I-385. Due to the congestion between Pelham road and SC 14, additional cameras may be beneficial in that area.

Although the TMC personnel do an excellent job with limited resources SCDOT should consider expanding their current system to include the following:

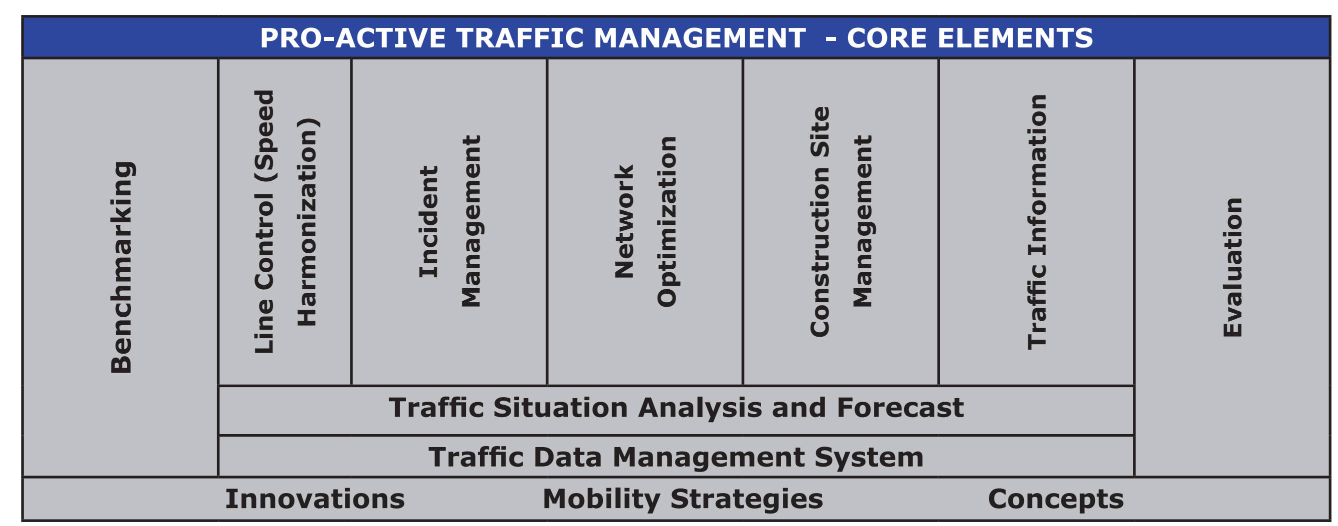
1. Expand camera coverage along the I-85 corridor to include cameras in the following general locations: Two additional camera locations between US 25 and Augusta Road, one camera between SC 291 and Mauldin Road, two additional cameras between Laurens Road and Woodruff Road, and one additional camera between Roper Mountain Road and Pelham Road. The 6 additional cameras would cost approximately $ 180,000.
2. Expand the incident management system to major non-interstate routes to allow better response to major incidents such as complete interstate closures. Such coverage would include better signing for detour routes, the ability to change signal timings along the alternate routes, and the ability to provide the 511 service with enough detail to sufficiently advise motorists of current conditions.

Active Traffic Management (OP32A)

The current traffic management strategy in the study corridor is reactive in nature. The operators react to changing traffic conditions based primarily on observations from traffic cameras along the corridor. The current Traffic Management Center provides an excellent foundation for the development of Active Traffic Management, a proactive approach to congestion management.

Active Traffic Management is the ability to dynamically manage recurrent and non-recurrent congestion based on prevailing traffic conditions. Focusing on trip reliability, it maximizes the effectiveness and efficiency of the facility. It increases the throughput and safety through the use of integrated systems with new technology, including automation of dynamic deployment to optimize performance quickly and without delay that occurs when operators must deploy operational strategies manually. This congestion management approach consists of a combination of operational strategies that, when implemented in concert, fully optimize the existing infrastructure and provide measurable benefits to the transportation network and the motoring public. These strategies include, but are not limited to speed harmonization, temporary shoulder use, junction control, dynamic signing and rerouting, and managed lanes.[5]

Exhibit 76: Active Traffic Management Concept[6]



A pro-active approach to congestion management (as illustrated in Exhibit 76) should include two objectives. The first is to maintain or increase safety by harmonizing traffic speeds, providing incident warnings to motorist, and providing dynamic information to motorist on traffic conditions. The second is to maintain and improve mobility by optimizing the existing road capacity and using a variety of operational strategies to temporarily increase road capacity. This approach includes benchmarking road

[6]Active Traffic Management: The Next Step in Congestion Management, Report FHWA-PL-07-012, July 2007,

performance, deploying and maintaining various traffic strategies, data management, traffic analysis, and forecasting to evaluate and assess the impacts of various strategies. The various strategies that may be included in this Active Traffic Management approach are briefly discussed on the following page.

Communication, Traveler Information, Data, and Performance Monitoring
Technologies such as loop detectors, video cameras, and other sensors are deployed along the roadway. The data gathered is used to determine traffic flow, speed, headways, travel time, and percentage of trucks. This information is used to estimate congestion levels and predict performance. The TMC would use this data to provide travel information to users and to mange congestion. Information on the equipment needs for Active Traffic Management is included in Appendix A.

Speed Harmonization
Traffic volumes and weather conditions along the route are monitored automatically for sudden changes. If a sudden change occurs, the system modifies the speed limits dynamically and provides motorist with the quickest possible warning of changing conditions. To optimize the speed harmonization strategy, traffic simulation software would interface with the speed harmonization system to determine the most effective deployment of speed harmonization strategies and handle speed distribution across all traffic lanes. Component strategies of speed harmonization may include queue warnings, temporary shoulder use, ramp metering, junction control (merge lane priority), HOT lanes, and truck restrictions.

Dynamic Rerouting and Traveler Information
When an incident occurs, advanced technology may be used to provide dynamic rerouting information to motorist. The TMC operators would provide alternate route information along I-85 and on other roadways as needed. Information would be displayed on overhead DMS.

Benefits of Active Traffic Management
The benefits experienced in a number of European countries that have Active Traffic Management programs are noted below.

- Increase in average throughput during congested periods of 3 to 7%
- Increase in overall capacity of 3 to 22%
- Decrease in primary incidents of 3 to 30%
- Decrease in secondary incidents of 40 to 50%
- Overall harmonization of speeds during congested periods
- Decreased headway and more uniform driver behavior
- Increased trip reliability
- Ability to delay the onset of freeway breakdown

Summary and Recommendation for Active Traffic Management
Active Traffic Management combines the power of modern technology in data collection with the predictive ability of traffic simulation software to predict developing congestion. This allows pre-tested combinations of strategies to be implemented in a dynamic manner while simultaneously providing information to the motorist. Active Traffic Management optimizes the use of the existing highway while addressing safety needs. The current Traffic Management Center provides an excellent platform upon which to build a robust and proactive traffic management system that will serve the users of I-85 well. As technology and traffic changes, an Active Traffic Management system can adapt and continue to minimize traffic congestion by optimizing highway usage. Careful planning for implementation and future upgrades to the system is needed and is beyond the limits of this study. Information on the equipment needs for Active Traffic Management is included in Appendix A. It is recommended that a plan for the implementation of Active Traffic Management be developed.

9.7 SAFETY

Enhanced Incident Responder Services (OP33)

SCDOT incident responders are constantly praised for their efforts in assisting motorists in need on the interstates of SC. As with any area within SCDOT the incident responders would benefit from more personnel, newer equipment and less territory to manage. The current location for the incident responders in the Greenville-Spartanburg area is the old rest area on I-85 southbound north of SC 290. In order to better respond to incidents in the more congested areas and to reduce inefficiencies in travel times it is desirable to move the incident responders operation to a more centralized location for their coverage area, that would be easily accessible to the northbound and southbound lanes of I-85. A potential location for this facility is near the Brockman-McClimon Road Interchange off of the frontage road (Freeman Farm Road).

Off Road Crash Investigation (OP34)

Traffic incidents can greatly reduce the capacity of the freeway system. Even events on the shoulder of the roadway can reduce capacity up to 25%. A number of states have constructed accident investigation sites to assist law enforcement in investigating crashes in a safe, less disruptive area. These sites are generally screened from the through lanes of traffic, reducing the impact to capacity on the mainline.

It is recommended that the construction of at least one site in each direction in the vicinity of I-385 be developed to determine the effectiveness of providing visually separated investigation sites. An ideal site is available in the northbound direction at the old weigh station just north of I-385. This area could easily be screened with plantings and has adequate room for storing disabled vehicles. Although there is no apparent easy location on southbound I-85, it is possible to locate a site between Pelham Road and I-385. Construction would require additional right of way. The costs associated with modifying the weigh station site will be minimal. The cost for constructing a site SB would be approximately $150,000 plus the cost of additional right of way if needed.

Median and Shoulder Treatments (OP35)

Currently the mainline of I-85 has rumble strips on the right shoulder throughout the corridor. Due to the narrow width of the left shoulder no rumble strips are in place however double yellow raised pavement markers help to delineate the left shoulder. It is recommended that the barrier wall itself be delineated with barrier mounted flexible delineators to provide better visibility of the wall. The cost for installing the delineators for the entire length of the project would be about $12,000.

Adding Visual Barriers (OP36)

Concrete barrier wall is in place for the entire length of the project. The current wall varies in height throughout the project. High wall is in place from US 25 to just north of Mauldin Road, and from just north of Pelham Road to the end of the project. The remaining section from Pelham Road to Laurens Road is the old style low wall with glare screen on four of the major curves. This glare screen consists of plastic paddles attached to the top of the wall. It is recommended that high wall be constructed from near Pelham Road to near Mauldin Road (approximately 7.3 miles). This would eliminate the need for the paddles and improve the night time visibility for motorist and reduce the rubber necking at incident sites throughout the project. The cost for constructing the higher wall would be about $4,000,000.

9.8 ENVIRONMENTAL CONCERNS

Improvements to the operational management of the current roadway network include improved signing and pavement markings, establishing alternative route opportunities, ramp and interchange modifications, designation of high occupancy lanes, as well as other traffic management tools. These efforts are reasonably unintrusive towards outlying areas and many of these improvements represent minor "stand alone" improvements which can be environmentally processed by way of Categorical Exclusions. These minor projects represent a low cost investment that would reduce traffic congestion and motorist travel time through improved traffic flow. An increase in average vehicle running speeds and reduced idling time would benefit area air quality and likely lower noise levels in some locations.

Of the various operational improvements listed under this section of the document, alternative (parallel) route opportunities for motorists present the greatest potential for impacting outlying areas. To be effective, the use of existing roads as alternatives to the use of I-85 would need to be upgraded through improved signalization, signing, and other traffic control measures. In some instances, widening would be necessary to accommodate increased traffic volume along these routes. Widening of the existing roadway presents the potential for impacting homes and businesses, water bodies, and other natural as well as cultural resources.

Alternative routes to the use of I-85 have been listed in Exhibit 77 along with their potential for impacting human and natural resources. It is believed that these projects would require the preparation of individual Environmental Assessment (EA) type documents for each project in order to better assess their potential effects. Preparation and circulation of the environmental document followed by public hearings would be the normal procedure before federal funding can be secured for their construction. Final determination as to the level of environmental documentation required will be made by the FHWA in consultation with the SCDOT.

Exhibit 77: Areas of Potential Effects

Areas of Potential Effects								
Project	T/E	Cultural	Hazmat	Relocation	Recreational resources	Noise Barriers	Streams	Wetlands
Garlington Road Widening		X		X		X	X	X
Roper Mt. Road Widening		X		X		X	X	
Blacks Drive Widening		X		X		X	X	X
Mauldin/Laurens Road Conn. (North of I-85)		X				X	X	X
Mauldin/Laurens Road Conn. (South of I-85)		X				X	X	X
SC Route 14 Frontage Road Extension		X				X	X	X

A review of current environmental records reveals the potential for many of the projects to involve work within several watercourses. Only the Roper Mountain Road proposal does not appear to impact waterways or wetlands. The widening of Garlington and Blacks Drive crosses Rocky Creek while the Mauldin/Laurens Road Connection project traverses the Reedy River. An unnamed creek is located within the limits of the SC Route 14 frontage road extension. The type of work that may be needed within these waters should be eligible for processing under the SCDOT General Permit for construction in wetlands.

None of the projects would impact known federally listed endangered or threatened species, cultural resources, or public recreational areas. However, additional in-depth corridor studies would be needed at time of project development to verify the absence of these interests. Contingent upon right of way requirements for each project, displacement of residences or commercial structures may occur. All projects would require noise studies to assess impact on adjacent property owners.

I-85 Interchange/Ramp Improvements

The interchange and ramp improvements pose little effect on the surrounding environment. Each project will take place within the existing I-85 right of way and therefore not impact critical wildlife or their habitat, cultural or recreational resources, HAZMAT or waste generating sites, nor result in the displacement of homes, businesses, or institutions. There may be instances where construction activities require the extension of existing culverts thereby impacting small creeks. Brushy and Rocky Creeks lie within the proposed limits of I-385/Pelham Road fourth-lane construction and expanding Pelham Road exit ramps and therefore some work may occur in these watercourses and adjacent wetlands. This work activity can be permitted under the SCDOT General Permit for construction in wetlands. The work proposed under this category of improvements should not be of sufficient scope (inclusion of additional through lanes or significant change in horizontal or vertical alignment) as to warrant noise impact studies under 23 CFR 772. It is anticipated that these projects can be environmentally processed by way of Categorical Exclusions.

I-85 Mainline Improvements

Other improvements such as signing, relocating the incident response area, developing an off-road crash investigation site, and increasing the median barrier height are recommended. Similar to the interchange and ramp improvements listed previously, these I-85 recommendations can be accomplished within the existing rights of way. The projects would not impact any wetlands, streams or other water courses nor would they affect any known federally listed endangered or threatened species sites. Initial examination of the area surrounding these projects shows the absence of any significant adverse environmental effects and thus may also be environmentally processed through Categorical Exclusions.

All projects listed within this section of the document, should assist in improving traffic flow and safety while reducing traffic noise levels, motorist travel time and cost. The more efficient movement of vehicles resulting from less idling time and higher running speeds should provide measurable improvement of air quality in outlying areas.

9.9 SUMMARY OF OPERATIONAL STRATEGIES

The strategies previously discussed in this chapter are tabulated in Exhibit 78 along with additional details on cost and suggested implementation schedule. Many of the operational strategies could be implemented within a year or two with relatively low cost. Other strategies have a much longer development horizon and are associated with more extensive capacity improvements. Several of these strategies could be implemented in steps and are suitable for a collaborative effort between state and local government transportation agencies. Several strategies are sufficiently low in cost that a single agency could undertake one or more of the low cost strategies. As an example, several parallel route improvements are relatively low cost and could be funded by a single entity. While the effectiveness of a number of the improvements are difficult to determine individually, the combined effect will produce a safer, more efficient freeway.

[See Exhibit 78: Operational Improvements Summary on next page]

Exhibit 78: Operational Improvements Summary

Label	Strategy	Recommendation	Benefit	Timing	Cost (x $1000)	Associated Strategies
OP1	I-385/Woodruff Road CD Exit at I-85 SB	Re-stripe to provide a 2-lane exit	Reduces congestion Improves safety	2012	50	OP4, OP13
OP2	SC 101 Acceleration Lanes at I-85 NB and SB	Increase length of acceleration lanes by striping	Improves safety	2012	25	
OP3	I-385/Woodruff Road CD Exit at I-85 NB	Construct 2-lane exit ramp, lengthen deceleration lane	Reduces congestion Improves safety	2015	3,850	C11, C20
OP4	I-385/Woodruff Road CD Exit at I-85 SB	Lengthen deceleration lane	Reduces congestion Reduces emissions	2015	960	OP1, C11
OP5	Pelham Road Exit at I-85 NB	Construct 2-lane exit and ramp, lengthen deceleration lane	Reduces congestion Improves safety Reduces emissions	2015	3,850	C6, C29, OP17
OP6	Pelham Road Exit at I-85 SB	Construct 2-lane exit and ramp, lengthen deceleration lane	Reduces congestion Improves safety Reduces emissions	2015	3,850	C8, C9, C11, OP17
OP7	SC 290 Exit at I-85 NB	Construct 2-lane exit and ramp	Reduces congestion Improves safety Reduces emissions	2015	3,850	OP8, C10, C15, C30, OP20
OP8	SC 290 Exit at I-85 SB	Construct 2-lane exit and ramp	Reduces congestion Improves safety Reduces emissions	2015	3,850	OP7, C10, C19, OP20
OP9	SC 14 Exit at I-85 NB and SB	Construct 2-lane exit and ramp	Reduces congestion Improves safety Reduces emissions	2025	3,850	C7, C8
OP10	SC 14 Acceleration Lane at I-85 SB	Construct 2-lane acceleration lanes and ramps	Improves safety	2025	4,800	C8, C10, C19
OP11	US 29 at I-85	Lengthen NB deceleration lane and SB acceleration lane	Improves safety	2015	1,900	
OP12	SC 129 at I-85	Lengthen NB deceleration lane and SB acceleration lane	Improves safety	2015	1,900	
OP13	Mainline Signing Improvements	OH sign on I-85 SB at I-385/Woodruff Road exit	Reduces congestion Improves safety	2012	80	OP1
OP14		OH signs on I-85 SB and NB exits to Pelham Road		2015	160	OP5, OP6
OP15		OH sign on I-85 NB at Brockman-McClimon Road		2015	75	
OP16		OH sign on I-85 SB south of Brockman-McClimon Road for SC 14 and GSP interchanges		2015	75	
OP17	Crossing Route Signing Improvements	Six OH signs on Pelham Road	Reduces congestion Improves safety	2012	300	OP5, OP6
OP18		Six OH signs on US 29		2012	300	
OP19		Six OH signs on US 276 (Laurens Road)		2012	300	
OP20		Signing for SC 290 DDI Interchange		2015	600	OP7, OP8, C10

Exhibit 78: Operational Improvements Summary Continued

Label	Strategy	Recommendation	Benefit	Timing	Cost (x $1000)	Associated Strategies
	Parallel Route Opportunities					
OP21	Mauldin Road to Laurens Road	Connect Kings Road to Duvall Drive	Reduces congestion on I-85 Improves safety	2015	3,400	
OP22	Mauldin Road to Laurens Road	Connect Dairy Drive to Wrenwood Road		2015	1,400	
OP23	Garlington Road Widening	Widen Garlington Road to four lanes from Pelham to I-385		2015	19,00	
OP24	Roper Mountain Road Widening	Widen Roper Mountain Road to four lanes from Garlington to Farringdon		2015	13,000	
OP25	Blacks Drive Widening	Widen Blacks Drive to Four lanes from Pelham to Roper Mountain Road		2015	12,000	
OP26	Frontage Road from SC 14 to SC 101	Extend frontage road from SC 14 to SC 101		2015	8,500	
OP27	US 29	Improve signals and install traffic cameras along US 29		2015	1,700	
OP28	SC 146/SC 296	Improve signals and install traffic cameras along SC 146/SC 296		2015	440	OP32
OP29	Woodruff Road, Verdae Boulevard, Laurens Road	Improve signals for parallel routing along Woodruff, Verdae, & Laurens		2015	500	OP32
OP30	Managed Lanes	Convert Existing Lane to HOV lane in each direction	Encourages ride sharing activities	2035	500	C31
OP31		Convert existing lane to HOT lane in each direction		2035	2,000 plus 1,100/year	C32
OP32	ITS - Existing Traffic Management	Expand traffic camera coverage on I-85	Reduces congestion Improves safety Provides traffic management for detour	2013	180	
		Expand incident management system to non-interstate routes		2015	300	TDM3, OP27, OP28
OP32A	ITS- Active Traffic Management	Develop implementation plan	Optimizes use of existing highway	2012	400	OP32
OP33	Enhanced Incident Responder Services	Relocate to near Brockman-McClimon Road Interchange	Reduces incident response time Improves safety Reduces congestion	2015	3,850	
OP34	Off-road Crash Investigation	Construct I-85 SB off-road crash investigation area	Reduces congestion during incident Improves safety	2015	150	
		Construct I-85 NB off-road crash investigation area		2015	20	
OP35	Median and Shoulder Treatment	Install delineators on median barrier	Improves safety	2012	12	OP36
OP36	Visual Barrier	Increase height of median barrier	Improves safety	2012	4,000	OP35
				TOTAL FOR OPERATIONAL STRATEGIES	**$105,977**	